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ARTICLES

STUDY OF HIBERNATING MOSQUITOES IN EASTERN EQUINE ENCEPHALOMYELITIS EPIDEMIC AREAS IN CONNECTICUT

ROBERT C. WALLIS,[1] RICHARD M. TAYLOR,[2] ROBERT W. McCOLLUM [2] AND JOHN T. RIORDAN [2]

One of the most interesting problems in the natural history of the arthropod-borne viruses is their mechanism of survival during inter-epidemic periods. This problem applies to eastern equine encephalomyelitis (EEE) in the New England States where virus has not been isolated except during the epidemic season. In 1956, Blackmore and Winn (1) reported isolation of western equine encephalomyelitis (WEE) virus from one of 31 pools of *Culex tarsalis* collected during the winter in Colorado and suggested that under certain conditions WEE virus might persist from one active transmission season to the next within overwintering mosquitoes.

Study of the possibility of the EEE virus overwintering in New England in hibernating mosquitoes was begun in 1955, when 640 hibernating *Culex pipiens* were examined for virus with negative results (2). The purpose of this report is to present results of further study of overwintering mosquitoes collected in the proximity of farms in Connecticut where there has been confirmed virus activity.

PROCEDURE. Mosquito hibernation places were found on or near seven farms which had a history of EEE virus activity. Details of these study sites are given in Table 1. Collection trips were made to the areas as long as hibernating mosquitoes were found during the period from September 1, 1956, to April 1, 1957. An average of two areas per week were visited, depending upon weather conditions. Care was taken to omit specimens of nonhibernating species which were occasionally found taking shelter in the hibernation sites during the early portion of the winter season. Only specimens which appeared to contain fat bodies and were believed to be hibernating were included in this study. Adult female mosquitoes were collected by hand aspirator and transported in cardboard cartons to the laboratory, where they were maintained alive at room temperature (76±4° F.) for three to five days. During this period they were provided with cotton pads saturated with 5 percent sucrose solution for food. At the end of this time the mosquitoes were stupefied with cigarette smoke, sorted into pools by species (Table 2), placed in small vials and stored in refrigeration (4° C.) overnight until transported to the virus laboratory for virus isolation.

Virus Isolation Procedures. The mosquito pools were triturated either in a porcelain mortar with pestle or in a Ten Broeck grinder, and suspended in the proportion of one mosquito to 0.2 ml. of Hank's balanced salt solution which contained antibiotics and was enriched by the addition of 0.5 percent lactalbumin hydrolysate and 2 percent calf serum (3). The suspension was centrifuged at 10,000 rpm for 20 minutes and the supernatant used for inoculation.

All of the 73 mosquito pools were inoculated into tissue culture and 31 were also inoculated intracerebrally (i.c.) into litters of one to three day old mice.

[1] Department of Entomology, The Connecticut Agricultural Experiment Station, New Haven, Connecticut.

[2] Section of Epidemiological and Preventive Medicine, Yale University School of Medicine, New Haven, Connecticut. (Study supported in part by grant from the National Institutes of Health, Bethesda, Maryland, and the Commission of Viral Diseases, Armed Forces Epidemiological Board, Washington, D. C.)

TABLE 1.—Collection sites in Connecticut from which hibernating mosquitoes were collected during 1956–1957

Collection Site No.	Place	Location in State	Hibernation Site	History of EEE Activity* in Proximity of Collection Site
1	Barn Island, Stonington	East-Coastal	Stone basement under abandoned house	Pheasant deaths—1947, 1951 Horse deaths —1938, 1953, 1956
2	Ked's Cave, Branford	Central-Coastal	Deep natural cave	Pheasant deaths—1951
3	Sherwood Island, Fairfield	West-Coastal	Stone outbuildings in State Park	Pheasant deaths—1956
4	Roxbury Iron Mine, Roxbury Falls	West-Central	Abandoned mine shaft	Horse death —1938
5	Shade Swamp Wildlife Management area, Farmington	Mid-Central	Eight artificial stone caves (shallow)	Pheasant deaths—1953 Rodent death —1953
6	Fitch's Farm, Jewett City	East-Central	Old stone basement under a house	Pheasant deaths—1955–1956 Horse death —1955
7	State Prison Farm, Enfield	North-Central	Old stone basement under fertilizer barn	Pheasant deaths—1956

* Confirmed by isolation of EEE virus.

Tissue cultures were prepared by mincing (with scissors) ten-day-old chick embryos (head removed) and washing them twice in buffered saline to remove excess red blood cells by allowing tissue fragments to settle, and discarding supernatant. The tissue was then treated with 0.2 percent trypsin in buffered saline at 37° C. for 20 minutes in a magnetic stirrer and filtered through two layers of gauze to remove the large fragments of the embryonic tissue. The suspended cells in the filtrate were sedimented by centrifugation for eight minutes at 800 rpm and washed twice with buffered saline solution; and finally, 1 ml. of packed cells was suspended in 499 ml. of enriched Hank's solution. The suspended cells were then distributed in 1 ml. amounts in culture tubes and the tubes tightly plugged with rubber stoppers.

The supernatant of the mosquito pools was inoculated in amounts of 0.1 ml. to each of three or more culture tubes. The tubes were incubated in a slanted position at 37° C. and examined every other day for six or more days.

Whether cytopathogenic effect (CPE) was observed or not, a second passage was made from a pool of the initially inoculated tubes and only after the second passage failed to reveal CPE were the results recorded as negative.

An account of experiences with tissue culture in the detection of EEE virus will be published later. It will suffice to say here that in this laboratory the tissue culture method has compared favorably with the infant mouse inoculation method.

RESULTS. From the seven collection sites listed in Table 1, a total of 2,569 hibernating mosquitoes were obtained. The number of pools and number of each species

TABLE 2—Hibernating mosquito species collected in Connecticut, number of pools and number of specimens tested for EEE virus, 1956–1957

Species	No. of Pools	No. of Specimens	Virus Isolation Results
Culex pipiens	33	1337	neg.
Culex salinarius	21	910	neg.
Culex restuans	6	115	neg.
Culex territans	6	33	neg.
Anopheles quadrimaculatus	3	132	neg.
Anopheles punctipennis	4	42	neg.
Total	73	2569	0

are listed in Table 2. From a total of 73 pools, 33 (1,337 specimens) were of *Culex pipiens*—the species encountered in greatest abundance in hibernation sites. A total of 21 pools of *Culex salinarius* (910 specimens) were processed. These were primarily from collections obtained from Site #1 at Barn Island, in southern Connecticut, where this species was particularly abundant. The remaining 18 pools consisted of various numbers of four other species (Table 2) which were found hibernating throughout the winter. From the total of 2,569 specimens studied, no virus isolations were obtained.

Discussion. This study had two objectives relating to the question of EEE virus overwintering in Connecticut in hibernating mosquitoes. The first was to obtain information on the number and species of mosquitoes which hibernate in areas where EEE virus was known to have been active, and the second was to ascertain if these mosquitoes harbored EEE virus.

Notwithstanding the difficulties involved in locating hibernating sites for mosquitoes, it is felt that this study rather clearly indicates that the number of mosquito species which commonly hibernate in the adult stage in Connecticut is quite limited. In fact, only six species (Table 2) were found. Of these, only *Culex restuans* is known to be capable of transmission of the virus (4). While virus isolations have been obtained from *Culex salinarius,* (5) transmission by this species is considered unlikely (4). During the periods of active transmission, the virus has been most frequently isolated from *Culiseta melanura* (5, 6, 7, 8) and this mosquito is presumed to be the most important vector. However, no hibernating specimens of this species were found and there is no other evidence that this mosquito hibernates in the adult stage. Among those suspected of being capable of transmitting the virus only mosquitoes of the genus *Culex* were found hibernating. Barr (9) has pointed out that after a blood meal has been taken it seems improbable that *Culex* mosquitoes can undergo the physiologic adaptation process (gonadotropic-dissociation) which is necessary to convert from egg production to hibernation. Since, so far as is known, it is necessary that a blood meal from an infected host be taken by the mosquito in order for it to become infected, it is highly improbable that the virus can be harbored by hibernating mosquitoes of this genus.

The failure to isolate virus from the rather limited number of mosquitoes examined may not be of significance. Yet it should be remembered that these mosquitoes were collected in places where the environment was favorable to the propagation of the virus during previous years. In addition, due to the vast reduction in the mosquito population during the winter season, small numbers in collections represent a proportionally greater sample of the population than do large collections during the summer season when the population is greatly expanded. Considered alone, this negative finding bears no great weight, but it is in keeping with other evidence of a

negative nature. Although these studies have unearthed no evidence favoring the concept of EEE virus overwintering in hibernating mosquitoes, admittedly they do not eliminate the possibility of this occurring.

SUMMARY. During the winter of 1956–57 hibernating mosquitoes were collected from seven localities in Connecticut where there had been history of eastern equine encephalomyelitis (EEE) virus activity. The 2,569 specimens collected represented six species: *Culex pipiens* 1,337, *Culex salinarius* 910, *Culex restuans* 115, *Culex territans* 33, *Anopheles quadrimaculatus* 132, and *Anopheles punctipennis* 42.

The mosquitoes were currently pooled according to species, triturated and inoculated into chick embryo tissue cultures for detection of virus. Thirty-one of the 73 pools were also inoculated into infant mice. No virus was isolated.

The implication of these observations upon the overwintering of EEE virus in hibernating mosquitoes in Connecticut is discussed.

References

1. BLACKMORE, J. S., and WINN, J. F. 1956. A winter isolation of western equine encephalomyelitis virus from hibernating *Culex tarsalis* Coquillett. Proc. Soc. Exper. Biol. and Med., 91, 146.

2. WALLIS, R. C., JUNGHERR, E. L., LUGINBUHL, R. E., HELMBOLDT, C. E., SATRIANO, S. F., WILLIAMSON, L. A., and LAMSON, A. L. 1958. Investigation of Eastern Equine Encephalomyelitis. V. Entomologic and Ecologic Field Studies. Amer. Jour. Hygiene 67(1):35–45.

3. MELNICK, J. L. 1955. Tissue culture techniques and their application to original isolation, growth, and assay of poliomyelitis and orphan viruses. Annal. New York Academy of Sciences, 61:754–772.

4. CHAMBERLAIN, R. W., SIKES, R. K., NELSON, D. B., and SUDIA, W. D. 1954. Studies on the North American arthropod-borne encephalitides. IV. Quantitative determinations of virus-vector relationships. Amer. Jour. Hyg., 60, 278.

5. BARBUTUS, PAUL P. 1956. Personal communication.

6. CHAMBERLAIN, R. W., RUBIN, H., KISSLING, R. E., and EIDSON, M. E. 1951. Recovery of virus of eastern equine encephalomyelitis from a mosquito, *Culiseta melanura* (Coquillett). Proc. Soc. Exper. Biol. and Med., 77, 396.

7. HOLDEN, P., MILLER, B. J., and JOBBINS, D. M. 1953. Isolations of eastern equine encephalomyelitis virus from mosquitoes (*Culiseta melanura*) collected in New Jersey, Proc. Exper. Biol. and Med. 87, 457.

8. HAYES, RICHARD O. 1957. Personal communication.

9. BARR, A. RALPH. 1956. Personal communication.

COLONIZATION OF *AEDES TAENIORHYNCHUS*

A. NELSON DAVIS
Entomology Research Division, Agr. Res. Serv., U.S.D.A.

Salt-marsh mosquitoes, *Aedes taeniorhynchus* (Wied.) and *A. sollicitans* (Walk.), have developed resistance to DDT, BHC, and dieldrin in several coastal areas of Florida where these insecticides have been used extensively. Laboratory investigations of more effective materials and methods of control for these species have been carried out in the past with field-collected larvae and pupae. These investigations have been hampered by the irregular occurrence of broods, even during the normal breeding season, and by difficulty in getting sufficient numbers in suitable condition for testing. For these reasons the laboratory studies could not be carried on continuously in keeping with the importance of the problem.

To meet the demands for specimens, insectary rearing of *taeniorhynchus* was begun at the Orlando, Fla., laboratory in April, 1957. The colony was started with field-collected eggs, larvae, and pupae from salt marshes in Brevard and Volusia Coun-

ties, Fla. These marshes produced mosquitoes that were difficult to control with chlorinated hydrocarbon insecticides. Since no successful colonization of this species had been reported, various techniques were tried in an effort to find the most suitable conditions for maintaining the adults and for oviposition, as well as methods for hatching the eggs and rearing the larvae. Satisfactory procedures have been developed and a colony established which will provide an adequate supply of *taeniorhynchus* larvae and adults for insecticide studies.

The adults are kept in a cage 30 inches square by 25 inches high, with sides of 18-mesh screen and top and bottom of ¼-inch plywood. A front opening, 12 by 15 inches, is closed by a cloth sleeve 30 inches long. Temperature is maintained at about 84° F. and relative humidity at 70 percent. The cage is located in the north side of the room in front of a window through which natural light is available. Undiluted honey and fresh water are provided at all times. A shaved rabbit is placed in the cage daily for 2 to 3 hours. The racks used to hold the rabbits were patterned from a holder designed by Laug (1944). Eggs are collected on damp sphagnum moss,[1] contained in a white enameled pudding pan 9 inches in diameter and 3 inches deep.

For the parent generation approximately 6,000 pupae were placed in the breeding cage for emergence. Three days after the first emergence a shaved rabbit was placed in the cage for the initial blood meal. The sphagnum moss was introduced 3 days later and allowed to remain for 25 days, after which time most of the adults were dead. The moisture content was checked (by touch) daily and water added as needed. When the moss was examined for eggs, great numbers were observed at all levels.

Approximately 20 percent of the moss was transferred to a clean pudding pan and inundated with 2 liters of tap water. Most of the eggs were washed from the moss and settled to the bottom of the pan. The remaining eggs were separated by gently agitating by hand. Hatching began within a few minutes after inundation and was apparently complete within a few hours. About 10,000 larvae were produced. Twenty-four hours after inundation the larvae were distributed in 20 pudding pans, each containing 2 liters of infusion water. This water was obtained by inundating a salt-marsh sod 8 inches in diameter by 1 inch thick with 2 liters of tap water and allowing it to stand for 24 hours. The larvae were fed powdered dog food twice daily. Pupation commenced in 6 days and was completed in 12 days; most of the larvae pupated in 10 days. About 9,150 pupae were placed in the breeding cage for emergence of adults.

From 50 to 75 percent of the insects produced each generation have been utilized in testing, and the colony has been maintained with 10,000 to 20,000 adults. Now in the F^5 generation, the insects are of normal size and vigor. There has been no indication of a reduced fecundity in successive generations.

[1] J. S. Haeger suggested the use of sphagnum moss as an oviposition medium.

Reference Cited

Laug, E. P. 1944. A multiple rabbit holder. Jour. Lab. and Clin. Med. 29:308–311.

A POPULATION STUDY OF THE *CULICOIDES* OF FLORIDA (DIPTERA: HELEIDAE)

ELISABETH C. BECK
Florida State Board of Health, Bureau of Entomology

INTRODUCTION. During the years 1955 and 1956 a study was made by the Bureau of Entomology, Florida State Board of Health, to learn something of the seasonal abundance of the various species of *Culicoides* occurring in this state.

Florida is a peninsula of low elevation with broad lowlands around the entire coast. These lowlands are characterized by pine forests and palmetto, interspersed with cypress or mangrove swamps. This vast area of mangrove swamps, marshes, and tidal flats breeds tremendous numbers of the salt-marsh species of *Culicoides: furens, canithorax,* and *melleus.* Inland, the numerous lakes, ponds, rivers, streams, swamps and tree holes afford breeding places for the fresh water species. Consequently, sand fly annoyance is a major problem in Florida.

Six regularly operated mosquito light traps were the sources of material for this study. During 1955 and early 1956, the *Culicoides* from each of these traps were counted and identified from one collection each week during the year. Beginning in May, 1956, through December of that year, counts were made twice each week. If a collection ran high enough to make counting and identifying the total collection impractical, aliquots were identified.

During the two-year study approximately 108,000 specimens, representing twenty-five species, were identified from these six traps.

The majority of the faunal studies done on *Culicoides* in the past have been based on light trap collections. The studies of James (1943), Fox and Kohler (1950), Beck (1952), Khalaf (1952), Fox (1953), Fox and Capriles (1953), Williams (1955), and Wirth and Bottimer (1956), all indicate that light traps do attract large numbers of *Culicoides* species.

Light traps have these obvious advantages: they are comparatively inexpensive to operate; they require little of the collector's time; and the efficiency of the light trap (within the limits of its location) is the same in different areas, giving a "standard" collection at different times and in different localities.

F. W. Preston (1948) says that a sample will be a sufficiently accurate replica of the universe (parent populations) provided: it is a perfectly "random" sample, and no species is represented by fewer than 20 or 30 individuals. He continues: "A light trap is satisfactory in this respect [with respect to commonness or rarity] and samples its own universe appropriately. It is definitely *selective* in respect of phototropism, but it is random in respect of commonness, i.e., it does not care which of two moths, equally phototropic, it catches, though one may be a great rarity and the other of a very common species."

While Preston bases his ideas on collections of moths, the same principles seem applicable to *Culicoides.* Certain facts should be kept in mind however:

1. Light trap collections, over a long period, are probably directly related to the actual numbers of phototropic species in the parent population, since long term collecting would tend to level out the effects of meteorological factors which influence size and kind of the collection.

2. Large collections in weekly or semi-weekly light trap catches are largely accidental, depending on whether or not they happen to coincide with emergences, and upon meterological factors.

3. Light trap collections favor not only those species which are phototropic, but also those which are active at comparatively lower temperatures. This is true because nights are cooler than days, and

some species may be annoying during a day, but not active during the following cooler night.

4. While there is no way of estimating accurately the total parent populations from the collections, the ratio of one positively phototropic species to another in these collections should be a fair estimate of the ratio in the parent populations. Also collections from different areas can be compared, giving an idea of relative size of the populations in two areas where the same species occur.

5. It should be borne in mind that a light trap samples a comparatively small area, probably not more than a mile radius of the trap. It therefore indicates the population of the trap area, and does not necessarily represent the geographical area as a whole.

Within these limitations light trap collections should show us what species are present in the area, which species are present in the greatest numbers, and in which months the various species are most abundant.

The six traps used for this study were located so as to give as wide a variation in climate and ecological habitat as possible, as follows:

Light Trap Records. Trap #1. Highlands Hammock State Park near Sebring in Highlands County in south central Florida. There is a creek one-half mile east of the trap and a canal about one mile south. Both of these streams are bordered by marshy areas.

Twelve species, six in sizeable numbers. Most abundant were *inamollae, niger,* and *floridensis* in that order. Peak periods for the more common species were: *niger,* Feb.–Mar.; *knowltoni, haematopotus, stellifer,* Mar.–Apr.; *floridensis,* July–Sept.; *inamollae,* Aug.–Oct. Other species present at the trap were: *arboricola, crepuscularis, nanus, obsoletus, piliferus,* and *villosipennis.*

Trap #2. Vero Beach, Indian River County on the southeastern (Atlantic) coast; on U. S. 1, about 3 miles south of Vero Beach, at the edge of a hammock just outside the salt marsh bordering Indian River, on the mainland.

Ten species, but only one, *furens,* is taken in large numbers. It reaches a population peak Dec.–Aug. Also taken sporadically are *inamollae, haematopotus, arboricola, canithorax, crepuscularis, floridensis, knowltoni, melleus,* and *pusillus.*

Trap #3. Three miles north of Sneads, Jackson County, this trap is well inland in northwest Florida. The trap was set up to keep check on the mosquitoes attributable to the impoundment created by Jim Woodruff Dam. The trap is only about one-quarter mile from the impoundment.

Fourteen species, 5 fairly numerous. Most abundant were *crepuscularis* and *haematopotus,* followed by *arboricola.* Peak periods were: *niger,* Mar.–Apr., *crepuscularis* and *haematopotus,* Mar.–June; *stellifer,* May; *arboricola,* May–Sept. Also occurring at this trap were *biguttatus, khalafi, ousairani, piliferus, variipennis, venustus, villosipennis,* and *travisi.*

Trap #4. On the northern or bay shore of Sanibel Island in Lee County, on the southwestern (Gulf) coast of Florida. Red and black mangrove and gumbo-limbo trees are common in the area. The Gulf of Mexico lies about two and one-half miles away.

Ten species, 5 are fairly common. Most abundant were *furens* and *barbosai,* followed by *canithorax, melleus,* and *loughnani* in that order. Population peaks for the species were: *furens* and *barbosai* (on the basis of nine months collections) Mar.–July, and possibly Oct.; *crepuscularis,* March; *canithorax* and *melleus,* Mar.–May; *loughnani,* May–July. Some specimens of *arboricola, haematopotus, inamollae,* and *knowltoni* have also been taken in this trap.

Trap #5. St. Johns County, on the northeastern (Atlantic) coast, near St. Augustine. It is about three miles from the beach on Mantanzas Bay. Within a few hundred yards are ditches dug to make dikes to hold a fill. In dry weather the water is about one foot deep in these ditches; when it rains the whole area becomes swampy.

TABLE 1—Average number of *Culicoides* per light trap night taken at Florida locations 1955–1956 (Female Counts only)

	Highlands		Indian River		Jackson		Lee		St. Johns		Walton	
Culicoides	1955	1956	1955	1956	1955	1956	1955	1956	1955	1956	1955	1956
arboricola	.83	.44	.02	.01	5.33	3.88	.17	.63		.01	.17	.04
bermudensis											2.98	.30
biguttatus					.45	.10					.23	
canithorax			.02				6.44	19.01	1.11	.13	300.59	180.75
crepuscularis	1.08	.39	.08		46.39	1.48	4.14	1.19			1.15	.37
floridensis	6.46	2.84	.04	.09								
barbosai								59.43				
furens & barbosai							146.99	12.73				
furens			76.92	42.63				77.81	4.62	2.31	245.48	313.94
haematopotus	5.50	.28	1.96	.12	45.31	4.46	.27	.11	.21		.67	.11
inamollae	30.04	52.76	.85	3.78			.06	.02			.04	
khalafi						.04						
knowltoni	4.56	1.28	.11	.09				.13				
loughnani							5.94	10.49				
melleus			.02				8.35	13.21	5.49	13.40	4.44	2.24
nanus	.02											
niger	15.23	1.89			.51	.50				.01	.85	.14
obsoletus	.25	.04										
ousairani					.04	.08						
piliferus & spinosus					.76	.04						
piliferus	1.31	.37				.05						.03
pusillus			.04									
stellifer	3.35	.13			1.18	2.08				.04	.19	.67
travisi						.01						
variipennis					.06						.02	.09
venustus					.67	.10					.29	.05
villosipennis	.08	.01			.59	.74					.02	.01
unidentified	.02			.01	.04	.11			.02	.01	.71	
Total No. *Culicoides*	3583	4541	4161	3552	5168	1175	8962	15,777	590	1317	29,008	39,399
No. nights traps operated	52	75	52	76	51	83	52	81	52	83	52	79
Average per light trap night (all species)	68.90	60.43	80.01	46.74	101.33	14.16	172.34	194.77	11.35	15.87	557.85	498.72

Seven species, 2 fairly abundant. *C. melleus,* with peak population Mar.–May, was the most common species, then *furens* with peak period Apr.–May. Also occurring in very small numbers were *arboricola, haematopotus, niger, stellifer,* and *canithorax.*

Trap #6. At Santa Rosa, Walton County, about one and one-half miles from Choctawhatchee Bay in northwest Florida. It is on a bayou with swampy areas at the edges and is about three miles from the Gulf beach. There are two ditches within a few hundred yards of the trap.

Thirteen species, 2 very abundant. The largest collections during this study were taken in the Walton County trap. Both *canithorax* and *furens* were taken in large numbers, several thousand specimens each per collection in some instances. *C. melleus* was the third most common species. Peak periods for these species were: *canithorax,* Apr.–May, smaller peak Nov.–Dec.; *furens* and *melleus,* May; *bermudensis* and *crepuscularis* August. Other species taken at this trap were: *arboricola, biguttatus, haematopotus, inamollae, niger, piliferus, stellifer, variipennis, venustus,* and *villosipennis.*

Table 1 shows the average number of females of each *Culicoides* species taken at each of the six light traps operated during 1955 and 1956.

Annotated Species List. (Dates at end of each section represent the earliest and latest dates on which the species was collected.)

Culicoides inamollae Fox and Hoffman. This species occurs in large numbers in two traps, Highlands and Indian River Counties; larger numbers were taken at the Highlands trap. Catches from both traps indicate that this species reaches its greatest abundance during the late summer and early fall, the peak month being October. At Highlands the population is significantly high from August through December. (Jan. 4–Dec. 31.)

Culicoides niger Root and Hoffman. This species was taken in appreciable numbers at Highlands and Jackson County traps. More specimens were taken at Highlands, where it apparently emerges in large numbers earlier than it does in Jackson County. The peak months in Highlands are January through March, while in Jackson they are March and April, which may indicate earlier emergences in South Florida than in North Florida. (Jan. 4–June 28.)

Culicoides knowltoni Beck occurred in large numbers only at the Highlands trap. The peak population occurs in March and April. (Jan. 17–Dec. 31.)

Culicoides crepuscularis Malloch reaches its peak of abundance in traps from both Lee and Jackson Counties in March. In 1955 the species remained significant through July in Jackson County, but in 1956 only a few of this species were collected at that location. (Jan. 4–Dec. 13.)

Several gynandromorphs of this species were taken at the Jackson County light trap. In all cases the head appendages and body size were female, the genitalia male, and the abdominal cavity was always occupied by a mermithid worm. One gynandromorph of *haematopotus* was also taken at this trap.

Culicoides haematopotus Malloch occurred in large numbers at Jackson, Highlands, and Indian River County traps. At the Jackson County trap this species reached a peak in March, but was also at a high level through July. At Highlands the peak month was also March. At Indian River trap the number of specimens taken was too small to indicate a definite peak, though the larger catches occurred January through April. (Jan. 11–Dec. 31.)

Culicoides stellifer (Coquillett) was taken in appreciable numbers at Highlands and Jackson County traps. The peak in Highlands occurred in March, that in Jackson occurred in May. This again suggests that certain species may emerge earlier in the year in the southern part of the State. (Jan. 11–Nov. 15.)

Culicoides floridensis Beck was taken in significant numbers only at the Highlands trap. The population peak occurred July through September. (May 15–Sept. 8.)

Culicoides furens (Poey). Until April

1956, *C. furens* and *C. barbosai* were not separated. Subsequent identification has indicated that *barbosai* occurs at Lee County trap, but not at any other of the traps included in this study. Therefore, at Lee County, only collections taken since March 1956, are used for these species. This species is extremely abundant at the four coastal traps. However, the population peaks at the trap locations differ and in some areas more than one brood is indicated.

At Walton County, on the northwest gulf coast, *C. furens* occurs in large numbers from April through September. There was no evidence of a winter brood in either 1955 or 1956, the species being represented in each month from November through March by an average of fewer than one specimen per light trap collection. Of course, this could be because the species is inactive during the cold nights here.

In St. Johns County *C. furens* was taken in much smaller numbers. This was probably due to the exact trap location rather than the geographical location. Peak months were April and May.

At Indian River trap large numbers of *C. furens* were taken each month December through June, the peak occurring in April.

In Lee County, as previously noted, the records for *C. furens* were taken from collections made April 1956 through December 1956. These records indicate a significant population occurring May through July, and in October, suggesting two broods a year. (Jan. 3–Dec. 18.)

Culicoides barbosai Wirth and Blanton, is represented only in collections from Lee County, April through December, 1956. There is a sizable population April through July, and in October, with the peak in May. The close relation between the number of *furens* and *barbosai* present in the trap might suggest that these numbers reflect favorable collecting conditions rather than existing populations. That this is not the case is evident from the fact that other species present at this trap do not fall in the same abundance pattern. Consequently, it seems probable that *furens* and *barbosai* population abundance cycles may well run parallel courses, at least in the vicinity of this trap. (Apr. 10–Dec. 21.)

Culicoides arboricola Root and Hoffman, a tree hole species, was taken in large numbers only at the Jackson County trap. It was never very abundant, the largest single collection being sixty-six specimens. The population peak occured in July. (Feb. 7–Dec. 14.)

Culicoides melleus (Coquillett), a salt water species, reached a peak in March through May at both Lee and St. Johns County traps. In Walton County, where the species was less frequently taken, the peak occurred in May. (Jan. 2–Dec. 21.)

Culicoides canithorax Hoffman, also a coastal form, was taken in large numbers at Lee, St. Johns, and Walton Counties. At St. Johns trap it did not occur in large numbers; the peak was in March. In Lee County, where it was more common, the peak occurred March through May. In Walton County, where it occurred in extremely large numbers, the peak occurred March through May, but the species was present in great numbers every month of the year. *C. canithorax* was taken in larger numbers at the Walton trap than any other species at any trap studied. (Jan. 4–Dec. 27.)

Culicoides loughnani Edwards occurred only at the Lee County trap. It had a high population March through July, with the peak in May. (Jan. 11–Dec. 28.)

Culicoides bermudensis Williams was recorded only at the Walton County trap. It was not abundant in light trap collections there. The peak was in August, and it was only rarely present in collections for the rest of the year. (Mar. 13–Aug. 21.)

Eleven species of *Culicoides* occurred in such small numbers that no definite statements should be made regarding their seasonal trends. These low numbers may be due to: (1) actually very small populations, (2) very short period of abundance, (3) poor location of light traps with regard to their breeding areas, (4) negative phototropism.

Culicoides nanus Root and Hoffman is represented by a single specimen taken at the Highlands trap on May 24. *C. travisi* Vargas is also recorded from a single specimen, this from Jackson trap on May 8. *C. biguttatus* (Coquillett) was taken in small numbers in early spring at Jackson and Walton traps. (Apr. 6–May 15.) *C. obsoletus* (Meigen) was rarely taken at the Highlands trap. (Jan. 17–June 28.) *C. villosipennis* Root and Hoffman was taken at Jackson trap and a few specimens at Highlands trap. (Apr. 6–Oct. 25.) *C. ousairani* Khalaf (Apr. 6–Aug. 3) and *C. khalafi* Beck (May 15–Oct. 9) were taken only at the Jackson trap. At the Indian River trap two specimens of *C. pusillus* Lutz were captured. (Jan. 17, April 1.) *C. variipennis* (Coquillett) was taken in Jackson and Walton Counties. (May 3, Nov. 6.) *C. piliferus* Root and Hoffman occurred at Highlands, Jackson, and Walton Counties. (Mar. 11–May 15.)

It is evident that Florida has a large number of species of *Culicoides* and that these occur in great abundance. Many of these species are present for a greater part of the year. At least seven species have been taken every month in the year. Apparently, most species occur over a longer season in Florida than elsewhere, but in the case of *biguttatus, obsoletus, piliferus, variipennis,* and *venustus,* the period of occurrence was shorter than that given by Foote and Pratt (1954). These species are rarely taken in Florida, so that the small number taken may account for the shorter period recorded.

Summary. To summarize briefly, six light traps were operated at regular intervals in different areas of Florida in order to learn something of the relative and seasonal abundance of the various *Culicoides* species. Of the 25 species taken during this study, 14 were taken in large enough numbers to indicate that they contribute to the sand fly annoyance problem. On the coastal regions *furens, canithorax, melleus,* and possibly *loughnani* in some regions, are the problem. Inland, *inamollae* in South Florida, and *crepuscularis* and *haematopotus* in northern Florida appear to be the most abundant species.

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Literature Cited

Beck, E. C. 1952. Notes on the distribution of *Culicoides* in Florida (Diptera, Ceratopogonidae). Florida Ent. 35:101–107.

Foote, R. H. and Pratt, H. D. 1954. The *Culicoides* of the Eastern United States (Diptera: Heleidae). Pub. Hlth. Monog. #18. 55 pp.

Fox, I. 1953. Light trap studies on *Culicoides* in Puerto Rico. Jour. Econ. Ent. 45:888.

Fox, I. and Kohler, C. E. 1950. Distribution and relative abundance of the species of biting midges or *Culicoides* in eastern Puerto Rico as shown by light traps. Puerto Rico Jour. Pub. Health and Trap. Med. 25:342–349.

Fox, I. and Capriles, J. M. 1953. Light trap studies on mosquitoes and *Culicoides* in western Puerto Rico. Mosq. News. 13:165–166.

James, M. T. 1943. The genus *Culicoides* in northern Colorado. Pan-Pac. Ent. 19:148–153.

Khalaf, K. T. 1952. The *Culicoides* of Wichita Refuge, Oklahoma. Taxonomy and seasonal incidence (Diptera, Heleidae). Ann. Ent. Soc. Amer. 45:348–358.

Preston, F. W. 1948. The commonness and rarity of species. Ecology 29:254–283.

Williams, R. W. 1955. Observations on the bionomics of some *Culicoides* of Cheboygan County, Michigan, (Diptera, Heleidae). Bull. Brook. Ent. Soc. 50:113–120.

Wirth, W. W. and Bottimer, L. J. 1956. A population study of the *Culicoides* midges of the Edwards Plateau region of Texas. Mosq. News. 16:256–266.

MOSQUITO RECORDS FROM THE CHUKCHI SEA COAST OF NORTHWESTERN ALASKA

A. RALPH BARR AND PAUL R. EHRLICH *

This study was made in order to advance our knowledge concerning the geographic distribution and ecology of mosquitoes in Alaska. All of the field work was done by the junior author and the identifications by the senior author. The field work was done from June 15 to July 1, 1956 at which time the succession of species was in a later state than is normal for the locality. This was due to the unusually warm weather during the spring as shown by the local climatological data of the United States Weather Bureau for Kotzebue, Alaska.

COLLECTION RECORDS, KOTZEBUE, ALASKA. Kotzebue is a small town located on a spit projecting into Kotzebue Sound, an arm of the Chukchi Sea. There is no spruce forest within ten miles of Kotzebue, and the locality appears to be typical of the arctic tundra. There are, however, substantial growths of dwarf alder and willow near the town. The average altitude is about 10 feet above sea level.

A pool which had formed in a depression left by the removal of sod was examined on June 15. The pool was about 36 square feet in area and was polluted with drainage from garbage. Fifty larvae taken were all *Aedes fitchii*. From another lot, eleven adults were reared of which one was *A. fitchii* and the remainder *A. excrucians*.

On June 16 a large accumulation of water perhaps a quarter of an acre in area was examined. Larvae were found in shallow, shaded portions of the pool and were less abundant than pupae. Eight larvae were taken, of which four were *A. excrucians* and four *A. fitchii*. Eight pupae were reared of which seven were *Mochlonyx velutinus* and one *A. fitchii*.

A third breeding-place examined was part of an extensive fresh water slough. On June 23, pupae were more abundant than larvae and were found among emergent grasses. This slough is probably the principal source of mosquitoes in Kotzebue. Twenty-six larvae were taken, of which 20 were *A. excrucians* and six *A. fitchii*. Five hundred twenty-seven adults were reared of which 477 were *A. fitchii*, 47 *A. excrucians*, 1 *A. cinereus*, and 2 *Mochlonyx velutinus*.

TUNDRA AREAS NEAR KOTZEBUE. On June 18 a pool was sampled in the tundra about four miles south of Kotzebue. The altitude of the area is about 100 feet above sea level. Of three larvae taken, two were *Mochlonyx velutinus* and one *Aedes excrucians*. Fourteen adults were reared of which seven were *A. excrucians* and seven *A. nigripes*. Nine females were taken biting on June 20 and of these, eight were *A. nigripes* and one was *A. implicatus*. A single female was taken on June 23 which appeared to be *A. nigripes* as did six taken on June 27. On June 28, 108 females were taken which also appeared to be mostly, if not entirely, this species.

KIVALINA. This is a village about 80 miles northwest of Kotzebue. It is a treeless locality on an exposed spit projecting into the Chukchi Sea and is about six feet above sea level. It was visited on June 21, at which time five larvae and many pupae were found. Of the larvae, two were *A. fitchii*, one *A. nigripes*, one *A. pionips* and the other has been tentatively identified as *A. pullatus*. Thirty-five adults were reared, of which one was *A. nigripes* and the remainder *A. impiger*.

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Present address of the junior author: Chicago Academy of Sciences, 2001 N. Clark St., Chicago 14, Illinois.

Noatak. This locality, which is inland on the Noatak River 50 miles north northwest of Kotzebue, was visited on June 21. It is in an area of spruce forest. No immature mosquitoes were found but nine adult females were taken biting. Of these, six were *A. excrucians* and the remaining three appeared to be *A. nigripes*.

Shishmareff. Immature mosquitoes were collected at Shishmareff, a treeless locality about 110 miles west southwest of Kotzebue at the north end of the Bering Strait (on the north side of the Seward Peninsula). The collections were made in a slough about 50 yards from the beach on June 24. Two *A. nigripes* larvae were taken. Seventeen adults were reared which were also *A. nigripes*.

Deering. This locality is approximately 65 miles south of Kotzebue on Kotzebue Sound. It is also a treeless locality. Immature mosquitoes were collected on June 25 in a slough 40 yards from the beach. Thirty-eight adults were reared, of which 31 were *A. nigripes* and 4 *A. impiger*. The other three specimens could not be identified with certainty but were of the *punctor* subgroup of *Aedes*, possibly *hexodontus*.

Notes on the Species. *Aedes fitchii* (Felt and Young). The record from Kivalina is probably the northernmost one for *fitchii*. This species is considered to be one of the taiga rather than of the tundra and its presence at Kotzebue and Kivalina shows the presence of taiga elements in these treeless localities.

The identification of the species in northern Alaska presents no difficulties since the only other species in the area with white bands on the legs is *Aedes excrucians* which is easily recognized by the peculiar tarsal claws of the females. Biting females were not taken.

Alaskan specimens of *Aedes fitchii* are very similar to material from Minnesota both in the larval and adult stages. Females which have a white mesonotum with a brown median stripe are easily recognized although some females departed from this characteristic pattern. Usually there were white or yellowish-white scales on the mesonotum but occasionally the scales were yellow or golden, in which cases the females could be mistaken for other species of the *stimulans* group. In all of the material at hand, however, the tarsal claws are different from those of *excrucians* and the adults average considerably smaller in size. The colorational divergence mentioned above is likewise found in specimens from Minnesota which makes identification of females from that area almost impossible, since other species in this group are also present.

On the abdomen there are small to large, basal bands on the terga. These are usually white, rarely yellow. There are often narrow, apical, pale bands on the more posterior terga. The white bands are very distinct and there are no pale scales intermixed with the dark ones. Minnesota specimens, on the other hand, frequently have a sprinkling of pale scales among the darker ones.

Aedes excrucians (Walker). This species, like *fitchii*, is considered to be one of the taiga but its range is thought to extend further north than that of *fitchii*. The presence of the species at Kotzebue again demonstrates the presence of taiga elements there.

Specimens of larvae and adults of this species from Alaska are not noticeably different from Minnesota specimens. The females have yellow scales on the mesonotum and there may or may not be a distinct darker, median stripe. The abdominal terga have large, basal bands which are yellow, rarely whitish. There are also fairly large apical, pale bands on some of the terga and there is an intermingling of pale scales on the darker portions. Sometimes the dorsum of the abdomen is almost entirely yellow. All females are easily identifiable by the peculiar tarsal claws.

Aedes nigripes (Zetterstedt). This species is close to *impiger* as well as several other northern *Aedes*, and females are difficult to identify. Males and larvae, however, are more distinct. The species is most commonly found in tundra areas and is thus characteristically arctic.

Females have a dark golden brown mesonotum which lacks distinct stripes. The abdominal terga have broad, white, basal bands which are often very large. Occasionally the entire dorsum of the abdomen is covered with pale scales in which case the more apical scaling of the tergum is usually greyish rather than white. The shape of the tarsal claws appears not to be distinctive. Adults of this species are considerably larger than those of *impiger*, on the average.

Aedes cinereus Meigen. A single female of this species was reared from a pupa collected in Kotzebue. The species is holarctic and occurs as far south as the gulf coast in North America. It has been taken as far north as Dawson, Yukon Territory. The species is primarily found in the taiga, which again shows the presence of relatively southern elements at Kotzebue.

The one female taken lacked basal pale bands on the abdominal terga. The scutum was darker than in Minnesota specimens. This female was rather different from typical Minnesota specimens; the Alaskan form should be studied further.

Aedes implicatus Vockeroth. A single female of this species was taken while biting in the tundra near Kotzebue. The species is typically found in the taiga and its presence at Kotzebue reconfirms the presence of such elements there.

The one female taken was quite different from Minnesota females. In the latter there are two brown stripes on a coppery patch on the mesonotum. The sides of the mesonotum are covered with white scales. In the one Alaskan female taken there is a single, narrow, brown stripe on the mesonotum. The author has examined several hundred Minnesota specimens but has not seen this variation. The Alaskan form warrants further study.

Aedes impiger (Walker). This species is characteristically found in tundra areas. The adults are smaller, on the average, than those of *nigripes*. The coloration is similar but the mesonotum is usually not so reddish as in *nigripes*. There are distinct white bands on the terga and the sternopleuron is less extensively scaled than in *nigripes*. Fresh, unrubbed females of these two species can usually be separated, but doubtful females are common. The tarsal claws of the female appear to be useless in this separation.

Aedes pullatus (Coquillett) and *Aedes pionips* Dyar. A single larva of each of these species was identified tentatively. They were taken at Kivalina. The records are not improbable but must remain doubtful.

Aedes punctor subgroup. One male and two females of this group were reared from pupae. The adults cannot be identified with certainty in this group. These specimens are either *Aedes punctor* (Kirby), *A. hexodontus* Dyar, or *A. abserratus* (Felt and Young). On the basis of known distributions, *A. abserratus* is unlikely and *A. hexodontus* is somewhat more probable than *A. punctor*. The genitalia of the male were not those of *abserratus* but could have been either *punctor* or *hexodontus*.

Mochlonyx velutinus (Ruthe). Larvae and adults of this non-biting mosquito were taken at Kotzebue. It again is characteristically found in the taiga.

DISCUSSION. It had been expected that only species characteristic of the tundra would be found near Kotzebue but, although tundra species were present, several species not ordinarily taken in tundra areas were also found. Collections of Lepidoptera made at Kotzebue confirmed the impression that although the area is superficially arctic tundra (treeless), there are strong Hudsonian elements in the fauna. The occurrence here of *Erebia disa* Thunberg (a satyrid butterfly), which is almost universally associated with spruce woods, is an example.

DIFFERENTIAL FEEDING OF *CULEX TARSALIS* ON NESTLING AND ADULT BIRDS *

JOHN S. BLACKMORE AND RICHARD P. DOW

Introduction. The blood-feeding habits of *Culex tarsalis* Coq. have been studied extensively by many workers because of the mosquito's importance in the transmission of western equine and St. Louis encephalitis viruses. It is generally accepted that *C. tarsalis* feeds readily on numerous species of birds, but very little attention has been given to the relative feeding preferences for different species or different individuals within a species.

Unpublished data accumulated at the Greeley Field Station from sentinel pigeon cages in 1955 and 1956 indicated that *C. tarsalis* mosquitoes usually took blood meals in cages which contained mixed adult and nestling birds but fed infrequently when only adult pigeons were present. Subsequent studies were undertaken by members of the Greeley and the Logan Field Stations to compare the numbers of *C. tarsalis* that would take blood meals from adult birds and the young of the same species.

Colorado Tests: *Methods and Materials.* The study in Weld County, Colorado, was begun in lowlands near the St. Vrain River where large numbers of *C. tarsalis* had previously been collected in light traps and resting stations. Shortly after the beginning of the study, however, the mosquito population in this locality suddenly decreased so dramatically that the project was moved to a typical Upper Sonoran prairie environment where an intermittent stream favored intensive mosquito breeding. The adult *C. tarsalis* population in this area was dense and remained so during the remainder of the study. The observations were made from the first part of July to the last of August, 1956.

Three modified stable traps with Egyptian-type baffles were placed in a row with a space of about 20 feet between each trap. Three to five adult birds were placed in an exposure cage within the first stable trap. In the second trap the same number of unfeathered to slightly feathered nestlings of the same species was placed in a one-pound coffee can with the original nesting material, and several adult birds were held in mosquito-proof cages for added attraction. Since mosquito feeding is known to fluctuate from night to night, a "blood feeding index" was obtained by placing three adult pigeons in the third trap each test night. The bias of position was lessened by rotating the host birds each afternoon in such a manner that the birds experienced one exposure period in each of the three traps. Mosquito collections were made from the traps the following morning.

One of the stable traps is shown in Figure 1. Traps were constructed of quarter-inch plywood facing on a frame of 2- by 2-inch wood with 18 x 14 mesh wire screen serving as the baffle material. The outside dimensions of the trap were 4x4x4 ft. with baffles on two sides 24 inches high.

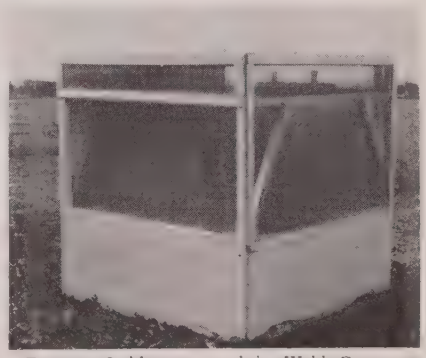

Fig. 1.—Stable trap used in Weld County, Colorado.

* From the Communicable Disease Center, Bureau of State Services, Public Health Service, U. S. Department of Health, Education, and Welfare, Greeley, Colorado, and Logan, Utah.

The main part of the baffle sloped inward 11 inches leaving a 1-inch-wide horizontal entrance between its upper margin and the inner margin of a horizontal shelf of screening 10 inches wide. A shelf at the bottom level of the baffle provided support for the test birds. Two by two mesh hardware cloth cages were used to hold the adult birds that were to be exposed to mosquitoes. The mosquito-proof cages used to hold the adult birds in the stable trap containing the exposed nestlings were constructed with a wood frame and covered with 18x14 mesh wire screen. The dimensions were 16x16x17 inches.

Results. The mosquitoes which entered the traps fed upon the nestling birds much more readily than upon the adults (Table 1). Nestling pigeons and barn swallows were the most efficient hosts. A very high percentage of the mosquitoes attracted to them took a blood meal. The adult pigeons seemed to be highly resistant to mosquito feeding even though they attracted relatively large numbers. The difference in engorgement rates between young and adult chickens was not as great as for the other species tested.

CALIFORNIA TEST: *Methods and Materials.* Four pigeons of the King breed, 2 adults and 2 squabs, were compared with respect to the attraction and feeding of *C. tarsalis* by exposure as bait in traps made from 120-pound lard cans. The 4-night test was conducted September 16–19, 1956, beside Poso Creek near the Oildale-Woody road in Kern County, California. The traps were suspended about 5 feet above the ground and slowly rotated for 2½ hours in a common circle 10½ feet in diameter. The apparatus used was a rotary similar to the device described in an earlier paper (Dow *et al.*, 1957), but differing in having a fixed post with the motor mounted near the top.

The 2 squabs, which were about 8–11 days old during the test, were removed from their nests in the late afternoon and returned the following morning. They were taken from 2 different nests in order to leave a sibling for the parents' attention and thus assure the continuation of their care. All 4 birds were tested each night in the same cages. The cages used for the squabs were provided with a hollowed nest of paper covered with a layer of plastic. Each cage was placed in a different one of the 4 traps each night, the test pattern being a randomized 4x4 Latin square.

Results. On the first 3 nights, which were warm and quiet, each trap collected from 112 to 456 female *C. tarsalis.* On the fourth night, which was still warm but comparatively windy, the catches ranged from 60 to 98 specimens. The percentages of the trapped mosquitoes which contained blood (Table 2) were reasonably consistent from night to night for each bird. The ranges for the squabs overlapped, as did those for the adults, but there was a wide gap between the highest percentage for either adult (24) and the lowest for either squab (55). The mean for both squabs was 82 percent, and for

TABLE 1.—*Culex tarsalis* mosquitoes caught in stable traps that were baited with adult and nestling birds of 4 species, Weld County, Colorado, July through August, 1956

Species of Bird Tested	Nestling Birds		Adult Birds	
	Total Mosquitoes Caught *	Percent Mosquitoes Containing Blood	Total Mosquitoes Caught *	Percent Mosquitoes Containing Blood
Pigeon (*Columba livia*)	291	96.1	239	6.2
English sparrow (*Passer domesticus*)	111	74.6	202	30.1
Barn swallow (*Hirundo rustica erythrogaster*)	585	97.9	437	32.6
Domestic chicken	131	81.8	104	51.1

* Numbers indicate totals for 3 nights' catches.

TABLE 2.—Attraction and feeding of female *Culex tarsalis* in rotary test of squabs and pigeons, Kern County, California, September 1956

	Squab A	Squab B	Adult A	Adult B
Wt. in gm., Sept. 20	304	332	482	569
Total *C. tarsalis* caught in 4 nights	932	608	1273	1047
Percent *C. tarsalis* with blood:				
First night	89	94	24	21
Second night	55	92	5	24
Third night	72	97	2	19
Fourth night	97	97	13	15
Whole test	74	94	9	21

both adults 15 percent. This difference was observed to be at least partly correlated with the activity of the birds during testing, the squabs being essentially motionless. The adults, however, tended to be restless, and adult B, especially, was inclined to assume fantastic contortions at the beginning of the test period.

Discussion and Conclusion. This study was designed to test whether mosquitoes, when once attracted to birds, were more likely to feed on nestlings or adults. Except in the California test, no attempt was made to compare their relative attractiveness. Since many species of birds nesting under natural conditions are in close proximity to their young during the hours of maximum *C. tarsalis* feeding activity, the amount of attractiveness of a bird nest is probably the sum of the attractiveness of the young and parent birds. Therefore, any difference in attractiveness between the young and adults would seem to be of minor importance.

The reason that a greater percentage of mosquitoes engorged themselves upon nestling birds is probably that the young birds were (1) nearly free of feathers and (2) more quiescent. The adult birds had a relatively hard "shell" of feathers which probably provided an efficient barrier to mosquito biting. The failure of mosquitoes to obtain blood through this barrier has been observed on several occasions in sentinel flocks of adult pigeons. Female *C. tarsalis* were observed to land on the feathers and eagerly seek an area of exposed skin. Usually, after several moments of probing with their proboscis, the mosquitoes would take flight. The few that did manage to consume a visible amount of blood did so by piercing the base of the beak, the legs, the feet, or the tissue around the eyes.

The present study indicates that nestling birds rather than adult birds were more frequently used as hosts by mosquitoes and may therefore be more important as reservoirs of encephalitis viruses. If this occurs under natural circumstances, birds that nest during the encephalitis season may be more important as reservoirs of virus than those that do not. Other factors, however, such as nesting sites, roosting sites, and total numbers, may modify or even negate the differential feeding on adults and young.

Reference Cited

Dow, R. P., Reeves, W. C., and Bellamy, R. L. 1957. Field tests of avian host preference of *Culex tarsalis* Coq. Am. J. Trop. Med. & Hyg. 6(2):294–303.

OBSERVATIONS ON THE ACTIVITY OF *CULICOIDES* AND OTHER DIPTERA IN JASPER COUNTY, SOUTH CAROLINA

W. E. SNOW,[1] EUGENE PICKARD,[1] AND C. M. JONES[2]

INTRODUCTION. In April, 1954, the senior author visited Jasper County, South Carolina, to observe methods being used by one of us (C. M. Jones) to investigate the activity of blackflies suspected of transmitting a leucocytozoon disease in turkeys (Jones and Richey, 1956). In addition to blackfly feeding on turkeys, he had previously noted several species of *Culicoides* feeding about the heads of the birds. Joint collections on April 15 in the vicinity of turkey feeders at the Cypress Woods Corporation near Ridgeland showed fair numbers of *C. canithorax* and *C. niger* present. Because of the authors' general interest in the feeding habits of *Culicoides,* subsequent collections were made by Jones between April 19 and June 1, 1954, and by Snow and Pickard on March 15, 1955, and May 30–31, 1957. Records of species collected in 1954 other than *C. niger* and *C. canithorax* have been published (Snow *et al.,* 1957). The current paper is mainly concerned with previously unpublished observations of *Culicoides* about the turkey feeders and those attacking man in the vicinity of the feeders and in a nearby tupelo bottom.

One turkey-raising area at Cypress Woods was situated about five miles north of Ridgeland between State Road No. 42 and Little Bees Creek. The feeders were present in an open area bounded on the south along State Road No. 42 by a swampy tupelo woodland. The local drainage system contains only fresh water, but all streams east of U. S. Highway No. 17 contain brackish water at least during high tides. The nearest brackish water and therefore probable source of *C. canithorax* and *C. furens* appeared to be about five miles distant in Bees Creek east of U. S. Highway No. 17 and in the Coosawhatchie River bottom several miles northeast of the Cypress Woods area.

COLLECTIONS IN 1954. At Cypress Woods two females of *C. niger* were captured feeding on a domestic turkey along a wooded stream in the 1600–1630 hr. period on March 31. Four specimens were also taken from a turkey in a nearby pine woods on April 23. Inspection of a turkey brooder house five miles north of Grays on April 19 showed four female *C. niger* resting inside on windows. Feeding of *C. niger* was recorded on April 15 in a stream bottom one mile north of Gillisonville when 17 specimens were captured while feeding on the arms of the two collectors between 1545 and 1600 hrs. Air temperature was 90° F. A collection of punkies on the arms and head of man in the open turkey feeder area at Cypress Woods on April 15 between 0600–0700 hrs. yielded 8 *C. niger* and 9 *C. canithorax.* Conditions were windy and hazy with a temperature change of 68–74° F. over the period. Occasional inspection of the outer surfaces of a nearby turkey feeder during this period showed 15 *C. niger* and 10 *C. canithorax* in resting position. A brief collection at about 1415 hrs. in the edge of a tupelo bottom just south of the turkey feeders showed slight activity of *C. canithorax* but none for *C. niger.*

COLLECTIONS IN 1955. Observations on feeding of *C. canithorax* at Cypress Woods in 1955 were carried out in the late afternoon and early evening hours of March 15 under overcast and unsettled conditions. A preliminary inspection of the turkey feeder surfaces showed a few unengorged punkies resting on the undersides of the tin roof and on the wooden walls. A series of 20 aerial sweeps along the walls of a feeder between 1730–1740 hrs. netted 24

[1] Malaria Control Branch, Div. of Health & Safety, TVA.
[2] Entomology Research Branch, Agr. Res. Serv., U.S.D.A.

C. canithorax. Captures in the open adjacent to the turkey feeders over the 1745–1800 hr. period (71° F.) showed 48 female *C. canithorax* biting man. In spite of a slow steady breeze the attack was direct on the hairy parts of the arms and on the lee side of the head especially about the ear. A hazy sun was present near the horizon. Sampling after dark at this site in the 1935–1950 hr. period by two collectors revealed only 2 specimens attempting to feed. Air temperature was 64° F. and slight air movement was detectable. Biting collections on man were also made along the margin of the tupelo bottom bordering the turkey feeder area. Two collectors recorded 110 female *C. canithorax* in the 1805–1820 hr. interval under hazy but fairly settled conditions and a temperature of 71° F. In an after dark collection between 1905–1920 hrs. none were found biting along the wooded margin. Temperature had dropped to 65° F. No other species of *Culicoides* were detected in those biting on March 15.

Collections in 1957. Greater effort was made in observations on May 30–31, 1957, to determine the prevalence of *Culicoides* at Cypress Woods by use of simultaneous ground and canopy collections in the wooded tupelo bottom adjacent to the turkey feeder area. It had been planned to make collections in the open feeder area and along the tupelo bottom at the same time, but it was found that turkey raising at Cypress Woods had been discontinued. Consequently it was concluded that the best information could be derived from paired collections in the wooded bottom where stratification might be taking place. A hickory tree growing along the west margin of the wooded bottom and about 20 feet inside the fence along State Road No. 42 was selected for use in observations on vertical distribution. Dense shade along the west margin of the woods kept the ground relatively free of herbaceous vegetation. The collector at the ground remained standing, whereas the collector at 30 ft. in the tree was seated.

In collections of previous years other Diptera had not noticeably annoyed man; however, mosquitoes, eye gnats, and occasional blackflies were encountered in addition to *Culicoides* on this visit. Activity in the early morning of May 30 was mainly observed at ground level for *Culicoides* and eye gnats. The eye gnats were prone to crawl on the arms and face. Records in the 0820–0920 hr. period showed ground level captures along the tupelo margin as follows: *Aedes infirmatus* (1), *A. taeniorhynchus* (2), *Culicoides canithorax* (1), *C. furens* (42), *C. paraensis* (1), and *Hippelates* sp. (30). According to Dr. C. W. Sabrosky, the *Hippelates* are related to a neotropical group and may be undescribed. The only Diptera active in the 30-ft. canopy station were females of *C. paraensis* (4). Temperatures rose slowly from about 73–74° F. and light intensity increased from 43–100 foot candles. Sunlight was first visible in the canopy at 0830 hrs.

Early morning, afternoon, and evening observations were made at ground and 30-ft. canopy levels in the margin of the tupelo bottom on May 31. Overnight rains had left the ground and foliage fairly wet, but conditions became drier with afternoon sunshine and a slight breeze from the west. In the morning period from 0623–0823 hrs. *C. paraensis* was the most active species with 26 specimens being taken at the 30-ft. level, while 6 were captured at the ground. On the other hand, *C. furens* was more evident at ground level where 5 were recorded as against 3 in the canopy. One specimen of *A. infirmatus* was collected at ground level. Temperatures fluctuated between 65–68° F., rising and falling slightly with cool breezes after 0700 hrs. Light meter readings at ground level were 42 ft.-c. at 0623 hrs., 73 ft.-c. at 0653 hrs., 79 ft.-c. at 0723 hrs., 65 ft.-c. at 0753 hrs., and 82 ft.-c. at 0823 hrs.

The early afternoon period of observation was from 1310–1410 and 1415–1445 hrs. with temperature fluctuating between 77–78° F. Light conditions under the forest canopy varied from 67 ft.-c. in cloudy moments to about 150 ft.-c. when the sun was shining. The *Culicoides* were more sharply stratified than in the morning

period with 26 *C. paraensis* at the 30-ft. level and 6 *C. furens* at the ground level. A blackfly, probably *Simulium slossonae,* was collected while probing on the arm of the collector in the tree canopy station. One *A. infirmatus* occurred at ground level. Adult *Hippelates* apparently subdued by cool wet conditions in the early morning period were quite active during the afternoon period. As it was difficult to determine numbers in flight about the collector, an estimate of prevalence was made by attempting to capture those landing and crawling on the clothing and exposed surfaces of arms and head. Since the numbers did not greatly diminish after net sweeping, an estimate of about 30 gnats has been given for each 30-minute period. Only 2 were caught at the 30-ft. level in the canopy.

The early evening period from 1855–2025 hrs. covered declining activity of diurnal species and a surge of nocturnal forms generally stimulated to flight shortly after sunset. Weather conditions were clear and calm until a slow breeze was felt about 1950 hrs. Temperature dropped from 77–76° F. to 72° F. over the period and light intensity declined from 18 ft.-c. at 1855 hrs. to about 1 ft.-c. at 1940 hrs. Results given in Table 1 show that *C. furens* was the principal species biting at ground level before dark with *C. paraensis* being about equally divided at ground and canopy levels. *C. niger* was represented only at ground level. At the beginning of the period the eye gnats were mostly seen flying just above pine needles on the ground and were not noticed after about 1905 hrs. The tree hole mosquitoes *An. barberi* and *Ae. triseriatus* were poorly represented and were recovered only in the canopy.

Following the decline of light intensity to about 1 ft.-c. at 1940 hrs., the feeding of *Culicoides* subsided and activity of *Culex salinarius* picked up sharply. Mosquito activity was maintained at ground level over the 1955–2025 hr. interval but dropped off in the canopy during the final ten minutes of the period. Although *Mansonia perturbans* was not very abundant, its high incidence in the canopy tended to support previous observations (Snow, 1955).

SUMMARY. Occasional observations on the feeding activity of *Culicoides* near Ridgeland and Gillisonville, South Carolina, during daylight hours in March and April 1954 showed *C. niger* feeding on turkey and *C. niger* and *C. canithorax* attacking man. Late afternoon collections in the vicinity of the turkey feeders at Cypress Woods Corporation north of Ridgeland on March 15, 1955, netted *C.*

TABLE 1.—Female Diptera taken on man at ground (Gr.) and 30-ft. levels in wooded bottom near Ridgeland, South Carolina, during an early evening period, May 31, 1957

Time:	1855–1925		1925–1955		1955–2025			
Temperature:	77–75	76–75	75–73	75–74	73–72	74–72	Total	
Level:	Gr.	30′	Gr.	30′	Gr.	30′	Gr.	30′
Species								
Anopheles barberi	—	—	—	1	—	—	—	1
Aedes atlanticus-tormentor	1	—	—	1	1	1	2	2
Aedes infirmatus	1	—	—	—	—	—	1	—
Aedes taeniorhynchus	-	—	—	—	2	—	2	—
Aedes triseriatus	-	—	—	—	—	1	—	1
Culex salinarius	—	—	3	—	106	32	109	32
Mansonia perturbans	—	—	—	—	2	5	2	5
Culicoides furens	16	—	18	—	2	—	36	—
Culicoides niger	1	—	1	—	—	—	2	—
Culicoides paraensis	9	8	3	3	—	—	12	11
Simulium slossonae	1	—	—	—	—	—	1	—
Hippelates sp.	4	—	—	—	—	—	4	—

canithorax from the walls of the feeders and revealed fair numbers feeding on man in the open until dark. Results of diurnal catches on man in tupelo bottom at Cypress Woods Corporation on May 31, 1957, indicated *C. furens* was mainly active at ground level and *C. paraensis* in the forest canopy.

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References

Jones, C. M., and Richey, D. J. 1956. Biology of blackflies in Jasper County, South Carolina, and some relationships to a *Leucocytozoon* disease of turkeys. J. Econ. Ent. 49(1):121–123.

Snow, W E. 1955. Feeding activities of some blood-sucking Diptera with reference to vertical distribution in bottomland forest. Ann. Ent. Soc. Amer. 48(6):512–521.

Snow, W. E., Pickard, Eugene, and Moore, J. B. 1957. The Heleidae of the Tennessee River Basin. J. Tenn. Acad. Sci. 32(1):18–36.

FIELD TESTS WITH ORGANO-PHOSPHATE GRANULAR INSECTICIDES AGAINST MOSQUITO LARVAE IN LAKE COUNTY, CALIFORNIA

LAWRENCE L. LEWALLEN [1] and HAROLD W. BRYDON [2]

The control of mosquito larvae with insecticidal sprays is frequently unsatisfactory when tall or dense plant growth occurs in the water. Much of the insecticide adheres to the plants and never reaches the water surface.

Herbicides can sometimes be used to reduce plant growth, making the water surface more accessible. This is done frequently, but such operations are costly and time consuming. When a rapid cleanup of a mosquito infestation is desired, in habitats characterized by dense vegetation, granular insecticides can often be used effectively (Rees, D. M., *et al.*, 1953; Rees, B. E., 1953; Labrecque, *et al.*, 1956). When properly applied, the granules sift down into the plant growth, ultimately reaching the water in a reasonably uniform pattern of distribution.

Experimental. The efficacy of Dylox and Guthion granules was evaluated against *Culex tarsalis* Coquillett and *Anopheles freeborni* Aitken larvae on the Anderson Ranch, Lake County, California in July, 1957. The granular materials were seeded by hand on ⅛ acre plots marked off into quadrants that contained low-growing lake margin vegetation. Granule size was from 30 to 60 mesh. Calcined montmorillonite, a member of the bentonite group, was used as the carrier for the insecticides.

Pre-treatment and post-treatment counts were made by taking 20 dips in each plot with a dipper six inches in diameter, equipped with a three-foot handle. Second, third, and fourth instar larvae were included in the counts for each species. Twenty-four hour mortality counts were made on each plot. The results of the tests are shown in Table 1. Dylox at 0.25 lb./acre and Guthion at 0.1 lb./acre were tested twice; the result of each individual test is shown in the table.

Guthion at 0.1 lb./acre produced considerable mortality of *Gambusia* sp.; at 0.25 lb./acre mayfly naiads were also killed. Dylox at 1.0 lb./acre produced no

[1] Senior Vector Control Specialist, California State Department of Public Health, Bureau of Vector Control.

[2] Manager-Entomologist, Lake County Mosquito Abatement District.

TABLE 1.—Results of field trials with granular insecticides against second to fourth instar *Culex tarsalis* and *Anopheles freeborni*.

Compound	Concentration lb./Acre	24 hr. % Mort. *C. tarsalis*	24 hr. % Mort. *A. freeborni*
Dylox	0.25	65 and 88	37 and 29
"	0.5	100	96
"	1.0	100	100
Guthion	0.1	100 and 87	20 and 0
"	0.25	100	83
"	0.5	100	100

mortality of *Gambusia*, Odonata naiads, or giant water bugs (Belostomatidae); mortality to mayfly naiads occurred at 0.5 lb./acre.

It is noteworthy that in these tests *A. freeborni* was more difficult to control than *C. tarsalis*. Usually the reverse situation holds.

CONCLUSION. Under conditions comparable to those experienced in these experiments Guthion could be used at 0.5 lb./acre, or Dylox at 1.0 lb./acre, in granular form for successful control of both *Culex tarsalis* and *Anopheles freeborni*. Dylox would be preferred to Guthion in situations where it is desirable to preserve predators of mosquito larvae.

References Cited

LABRECQUE, G. C., NOE, J. R. and GAHAN, J. B. 1956. Effectiveness of insecticides on granular clay carriers against mosquito larvae. Mosquito News 16(1):1–3.

REES, B. E. 1953. Some granular insecticides and parathion in mosquito control. Proc. & Papers 22nd Ann. Conf. Calif. Mosquito Control Ass'n, pp. 27–30.

REES, D. M., EDMUNDS, G. F., JR., and NIELSEN, L. T. 1953. Additional uses of granular larvicides in mosquito abatement. Proc. & Papers 22nd Ann. Conf. Calif. Mosquito Control Ass'n, pp. 20–21.

PUBLICATION ANNOUNCEMENT

The Proceedings of the Tenth International Congress of Entomology, held in Montreal, Canada, in August, 1956, are expected to be ready for distribution in late 1958. The price is $75.00 postpaid for the set of four volumes. Since a limited number will be printed only orders received before May 1, 1958, can be guaranteed.

The Proceedings will contain nearly 700 scientific contributions, many accompanied by illustrations. The four volumes, comprising over 4200 pages, will constitute an indispensable work of reference for many years since most of the material is not being published elsewhere.

For further information write to the address below: Tenth International Congress of Entomology, Science Service Building, Ottawa, Canada.

FIELD OBSERVATIONS ON THE HABITATS AND SEASONAL ABUNDANCE OF MOSQUITO LARVAE IN SCOTTS BLUFF COUNTY, NEBRASKA (DIPTERA, CULICIDAE)

LAFE R. EDMUNDS [1]

Principal Entomologist, Sanitary Engineering Branch, Engineer Research and Development Laboratories, Fort Belvoir, Virginia

Irrigation mosquitoes create a major vector problem in the western United States. A knowledge of the biology of these mosquitoes is essential for developing the most effective prevention and control measures. In order to understand more clearly the relationship between irrigation and mosquito production, studies were begun during the 1953 season on the biology and seasonal abundance of the immature stages in Scotts Bluff County, Nebraska. The investigations were made under actual field conditions, and in practically every habitat studied, a mixture of species was encountered. Scotts Bluff County was selected for study because much of the farm land is irrigated and heavy production of mosquitoes occurs during the summer months. *Culex tarsalis,* one of the commonest mosquitoes in the area, is believed to be the primary vector of encephalitis in the far west. Several other species in the area have been found to be naturally infected with encephalitis.

Methods. Some preliminary field observations were made during April to determine when mosquito development would start and which species would appear first. Beginning May 1, intensive collections and observations were started at forty-seven stations established in the vicinity of Mitchell, Nebraska. The stations were selected to obtain as complete a sample of mosquito larval populations as possible during the summer breeding season, and included representative types of aquatic situations occurring in Scotts Bluff County. The stations were inspected once each week, and larval populations were sampled by dipping with a pint-size white enamel dipper. The number of dips varied according to the size of the station. The average number of larvae or pupae per dip was recorded, and samples were collected for later identification or rearing in the laboratory. Associations of the pupae were made with the adults of each reared species.

Results. A total of 40,617 fourth-instar larvae and pupae of 12 species was identified from the various stations. Of this number, *Culex tarsalis* Coquillett made up 46 percent, *Aedes dorsalis* (Meigen) 25 percent, *Culiseta inornata* (Williston) 17 percent, *Aedes vexans* (Meigen) 10 percent, and *Aedes nigromaculis* (Ludlow) 1 percent. The remaining seven species, *Aedes triseriatus* (Say), *Culex pipiens* Linn., *Culex restuans* Theobald, *Culex salinarius* Coquillett, *Culex territans* Walker, *Anopheles walkeri* Theobald, and *Uranotaenia sapphirina* (Osten-Sacken) comprised only 1 percent of the collections (Table 1). Five species thus constituted 99 percent of the larvae and pupae collected. Due to the relative importance of these species, information concerning each is summarized in Table 2.

Seepage areas and temporary surface pools were found to be the most important mosquito-producing habitats in Scotts Bluff County. Collections of surface water occurred principally in depressions within the pastures and hay meadows that were irrigated. Many of these fields had not been leveled or graded, and because of irregular topography the fields were irrigated by wild flooding. Water applied in quantity enough to cover the high spots caused excessive ponding to occur in the

[1] This work was done while the author was Senior Assistant Scientist, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Mitchell, Nebraska.

TABLE 1—Percentage of fourth instar larvae and pupae collected from each type of habitat, Scotts Bluff County, Nebr., May–October 1953

Species	Seepage Areas	Surface Pools	Roadside Borrow Pits	Slough Along River	Concrete Structures	Tree Holes	Weed-Clogged Ditches	Percent of Total
Aedes dorsalis	3	54	68	—	—	—	x	25
Aedes vexans	3	20	15	93	—	—	13	10
Aedes nigromaculis	—	3	4	—	—	—	—	1
Aedes triseriatus	—	—	—	—	—	100	—	x
Culex tarsalis	66	21	7	7	100	—	40	46
Culex restuans	x	—	—	—	—	—	—	x
Culex pipiens	—	—	—	—	—	—	1	x
Culex salinarius	x	—	—	—	—	—	4	x
Culex territans	x	—	—	—	—	—	—	x
Culiseta inornata	27	2	6	—	—	—	41	17
Anopheles walkeri	x	—	—	—	—	—	—	x
Uranotaenia sapphirina	x	—	—	—	—	—	—	x
Total number larvae	23,481	13,339	3,244	220	27	35	271	40,617

x indicates less than 1 percent.

low areas. The water in the seeps came primarily from unlined irrigation canals. Soon after water was diverted into the canals in the spring, it began to appear in the seepage areas, where it remained until the canals were shut off in the late fall.

Culex tarsalis Coquillett: *Culex tarsalis* was given particular emphasis during this study because of its abundance and importance as a vector of encephalitis. Information concerning this species has been given in a previous paper (Edmunds, 1955), and will be reviewed only briefly.

Culex tarsalis was commonly found in association with *Culiseta inornata* in seepage areas, and with *Aedes dorsalis* and *Aedes vexans* in temporary surface pools. Information on seasonal occurrence and predominant breeding sites is given in Table 2.

Aedes dorsalis (Meigen) was frequently found in association with *Culex tarsalis, Aedes vexans,* and *Aedes nigromaculis* in temporary surface pools. Information on seasonal occurrence and breeding sites is given in Table 2.

Culiseta inornata (Williston): Larvae of *Culiseta inornata* were the first to appear in the area around Mitchell, Nebraska during 1953. On April 21, the first egg rafts of this species were collected from a small sheltered pool. Numerous egg rafts were collected from the same area but from a different pool on April 30. It was the only larval species found in the field during November.

Egg rafts of *Culiseta inornata,* collected in the field, during April and May were found to contain from 148 to 292 eggs, with an average of 204. The growth period from hatching to adult emergence, in permanent seepage areas, was 28 days at an average air temperature of 55.4° F.

TABLE 2—Collections of the five most common mosquito larvae in irrigated areas of Scotts Bluff County, Nebraska

Species	Seasonal Occurrence			Predominant Breeding Sites *				
	First	Peak	Last	1	2	3	4	5
C. tarsalis	5–7	7–11	10–29	S	TSP	RB	D	CS
C. inornata	4–21	7–11	11–26	S	P			
A. dorsalis	6–3	6–15	10–8	TSP	RB	S		
A. vexans	6–3	6–15	9–13	TSP	S			
A. nigromaculis	6–3	7–14	9–13	TSP				

S = seeps; TSP = temporary surface pools; RB = roadside borrow pits; D = ditches; P = ponds; CS = concrete structures.

Aedes vexans (Meigen): In general *Aedes vexans* developed in the same surface pools as *Aedes dorsalis* and *Aedes nigromaculis,* and achieved its highest populations at about the same time as these two species. In late August, however, *Aedes vexans* attained a high peak in larval populations which *Aedes dorsalis* and *Aedes nigromaculis* did not reflect. This was due to its breeding in overflow waters along the margins of the North Platte River. In these flood water pools *Aedes vexans* developed in large numbers and in almost pure cultures.

Aedes vexans was commonly found in association with *Aedes dorsalis* and *Aedes nigromaculis* in temporary surface pools.

Other Species. The larvae of *Culex pipiens, Culex restuans, Culex salinarius,* and *Culex territans* were collected in very small numbers, generally in shaded seepage areas in association with *Culex tarsalis*. *Aedes triseriatus* was collected only from tree holes. *Anopheles walkeri* and *Uranotaenia sapphirina* were found breeding in only one habitat, a seepage area exposed to sunlight and containing mostly sedge (*Carex* spp.).

Discussion. In Scotts Bluff County, large numbers of *Aedes dorsalis, Aedes vexans, Aedes nigromaculis,* and *Culex tarsalis* were produced in temporary surface pools that occurred in irrigated pastures and hay meadows. *Aedes dorsalis* was the dominant species found in these pools. Keener and Edmunds (1954) found that this species composed 81 percent of the larvae in temporary pools studied in the vicinity of Mitchell, Nebraska during 1952. Extensive seepage areas were formed early in the summer soon after irrigation began. The rising water levels of the seepage areas resulted in the production of large numbers of *Aedes* mosquitoes; however, *Culex tarsalis* soon appeared in most of the seepage areas and persisted there as the dominant species throughout most of the summer. In a previous study in the North Platte River Valley (Mitchell Field Station, 1952), *Culex tarsalis* made up 74 percent and *Culiseta inornata* 12 percent of all the fourth instar larvae from seepage areas in the North Platte River Valley, Nebraska.

Thompson (1953) found first instar larvae of *Culiseta inornata* hatching as early as April 11, 1950 in south central Nebraska. The writer first found egg rafts of *Culiseta inornata* on April 21, 1953, and breeding was continuous until freezing weather in late November.

Keener (1952) in studies of the hibernation of adult *Culex tarsalis* in cellars in western Nebraska, noted that in the spring of 1951 the hibernating *Culex tarsalis* adult females appeared to have left hibernation during the week ending April 28. In the spring of 1953 the writer attempted to determine the earliest date at which *Culex tarsalis* larvae hatched under natural conditions in the field. In Scotts Bluff County, a sample which contained first instar *Culex tarsalis* larvae was made from a seepage area near Mitchell, Nebraska on May 7.

Prevention and control of mosquitoes in Scotts Bluff County must take into account both the seepage areas and irrigated pas-

tures. Emphasis should be given to the elimination of habitats associated with irrigation. Measures to prevent seepage from canals should be utilized where needed and drains should be provided for the removal of surplus water.

SUMMARY. Twelve species of mosquitoes were found breeding in Scotts Bluff County, Nebraska during 1953. Listed in order of abundance they were: *Culex tarsalis, Aedes dorsalis, Culiseta inornata, Aedes vexans, Aedes nigromaculis, Aedes triseriatus, Culex pipiens, Culex restuans, Culex salinarius, Culex territans, Anopheles walkeri,* and *Uranotaenia sapphirina.* The first five species constituted 99 percent of the larvae and pupae collected.

During 1953 *Culex tarsalis* was found developing from May 7 to October 29, *Aedes dorsalis* from June 3 to October 8, *Culiseta inornata* from April 21 to November 26, *Aedes vexans* and *Aedes nigromaculis* from June 3 to September 13.

Most of the mosquito production occurred in seepage areas and temporary surface pools associated with irrigation. In the seepage areas *Culex tarsalis* was the most abundant mosquito and was commonly found in association with *Culiseta inornata.* In the temporary surface pools *Aedes dorsalis* was dominant and was generally associated with *Aedes vexans* and *Aedes nigromaculis.* Permanent control of mosquitoes in Scotts Bluff County will involve the elimination of seepage areas and surface pools on irrigated pastures.

Literature Cited

EDMUNDS, LAFE R. 1955. Notes on the biology and seasonal abundance of the larval stages of *Culex tarsalis* Coquillett in irrigated areas of Scotts Bluff County, Nebraska. Mosq. News 15(3):157–160.

KEENER, GEORGE G. JR., 1952. Observations on overwintering of *Culex tarsalis* Coquillett in western Nebraska. Mosq. News 12(3):205–209.

KEENER, GEORGE G. JR., and EDMUNDS, LAFE R. 1954. Field observations on larval growth rates of irrigated-pasture mosquitoes in western Nebraska. Mosq. News 14(3):131–138.

Mitchell Field Station, Water Projects Section, U. S. Public Health Service. 1952. Preliminary investigations of mosquito breeding in irrigation-seepage areas in the North Platte River Valley, Nebraska. P. 1–18.

THOMPSON, GEORGE A. 1953. Observations of early spring activity of *Culiseta inornata* (Williston) in south central Nebraska. Mosq. News 13(1):17.

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THE MOSQUITO EGG SEPARATOR

THE MOSQUITOES (CULICIDAE) OF THE MISSOURI VALLEY REGION OF NEBRASKA[1]

WILLIAM F. RAPP, Jr.[2]

Since the publication of the bulletin on the mosquitoes of Nebraska (Tate and Gates, 1944) many ecological changes have taken place, resulting in many changes in the mosquito population. This early work reported thirty-three species of the state and discussed them in a general way, giving no details on the mosquitoes of specific regions.

In the spring of 1952 there occurred the most disastrous flood of recent times in the Missouri Valley. As a result of this flood large areas of standing water were left in many areas of the flood plain. It was felt that this standing water represented a potential mosquito breeding area. Since little was known about the mosquitoes of the Missouri Valley of Nebraska it was decided to run a series of New Jersey mosquito light traps through the area.

Ecology. The Missouri Valley region of Nebraska represents the western extremity of the eastern deciduous forest biome. In the early days this forest area formed a strip ten miles wide, but modern agriculture has narrowed this forest strip so today it seldom reaches a mile in width. This forest river-fringe forms a sharp and conspicuous ecotone. Intergradation between the deciduous forest and grassland is extremely minor. In the case of mosquitoes this lack of intergradation is very noticeable. Rapp (1955) has shown that *Culex tarsalis* is found principally in the grasslands and is only rarely or accidentally found in the forested areas. The deciduous forest is composed principally of an oak-walnut community with a fringe area of willow. The shrub community is minor and in many areas is lacking due to destruction by cattle or frequent flooding. With the construction of large dams on the upper reaches of the Missouri by the Corps of Engineers, no longer will it be possible for floods of the magnitude of the 1952 flood to occur. Therefore, in time we can expect to find a well developed shrub community along the Missouri River especially since farmers are slowly learning that woodlands are not good areas to graze cattle.

Light Trap Locations. New Jersey type light traps were run at six locations. All light traps were run within the corporate limits of the cities so that they would sample the mosquitoes which were annoying the residents. The location of the traps and the number of nights of operation at each site were as follows: Rulo, 84; Peru, 48; Plattsmouth, 38; Blair, 45; Tekamah, 75; Dakota City, 16.

Figure 1 shows the geographic location of light traps.

Mosquitoes Taken. Twenty-two species were taken, with a total of 4207 individuals.

Anopheles barberi Coquillett. Only one specimen of this tree hole breeder was taken at Rulo.

Anopheles punctipennis (Say). This species is the commonest *Anopheles* in Nebraska and is most abundant in this region.

Anopheles quadrimaculatus Say. This species is of no medical importance in Nebraska. It reaches its largest population in Nebraska in the Missouri River region. The species seems to reach its peak abundance during August.

Anopheles walkeri Theobold. This species was taken only at Rulo and Tekamah; in both of these areas are large cattail (*Typha latifolia* L.) marshes which are especially favorable for this species.

[1] The author wishes to thank Mr. L. D. Beadle of the United States Public Health Service and Dr. L. R. Edmunds of the University of Mississippi, formerly of the United States Public Health Service for help in determining the specimens.

[2] Entomologist, Nebraska State Department of Health, Division of Sanitation, Lincoln 9, Nebraska.

FIG. 1.—Eastern Nebraska showing location of trap sites in Missouri Valley.

Uranotaenia sapphirina (Osten Sacken). This species is very rare in this region, only one specimen being taken at Blair in September.

Culiseta inornata (Williston). This species is of minor importance and occurs during June and September.

Orthopodomyia signifera (Coquillett). This tree hole species was taken only at Plattsmouth in August.

Psorophora ciliata (Fabricius). This species reaches its western limit in the eastern third of Nebraska.

Psorophora confinnis (Lynch Arribalzaga). This species is locally abundant in the Missouri River Valley region. The Peru area had the largest population during the 1952 season.

Psorophora discolor (Coquillett). This species was taken throughout the Valley but was most abundant in the Peru area where it represented 9 percent of the total catch.

Psorophora ferox (Humboldt). On June 3 and 4, 1953 the writer and Leslie D. Beadle, United States Public Health Service, made biting collections in the river bottom forests south of Rulo. This species represented 1 percent of the species collected.

Psorophora horrida (Dyar and Knab). On the evening of June 3, 1952 the writer and Leslie D. Beadle took two specimens of this species in a biting collection at Rulo.

Psorophora signipennis (Coquillett). Tate and Gates (1944) found that this species was abundant in certain areas but in the Missouri Valley region it is a rare species.

Aedes cinereus Meigen. This is a rare species in Nebraska and only two specimens were taken at Blair, in late July and early August.

Aedes dorsalis (Meigen). Although this species is of major importance in the irrigated lands of western Nebraska, it is of minor importance in the Missouri Valley region.

Aedes nigromaculis (Ludlow). Tate and Gates (1944) regarded this species as a major pest. In the Missouri Valley region it was rare except in the Peru area where it represented 16 percent of the total catch.

Aedes sticticus (Meigen). Many workers feel that this is a river valley breeder; however, it is rare in the Missouri Valley region. Two specimens were taken by light trap in Tekamah in June. Apparently this species does not come readily to light as the writer and Leslie D. Beadle in June, 1953 took one adult at Ponca State Park at Dixon County and three adults in woodland areas south of Rulo.

Aedes trivittatus (Coquillett). Tate and Gates state that this is a common species in eastern Nebraska. Our work indicates that it is rare in the Missouri Valley region.

Aedes vexans (Meigen). This is the most abundant species in the Missouri Valley region. There are apparently several broods per year as specimens were taken throughout the entire trapping period.

Culex pipiens Linnaeus. This is the second most abundant species in the Missouri Valley region.

Culex restuans Theobald. This species was found throughout the Missouri Val-

ley region, but was especially abundant at Rulo and Tekamah.

Culex salinarius (Coquillett). This species was rare except at Rulo where 25 specimens were taken.

Culex tarsalis (Coquillett). In general this species is uncommon in the Missouri River Valley of Nebraska (Rapp, 1955). However, at Blair, it was second in abundance and represented 34 percent of the total catch.

Culex territans Walker. This species was taken at several locations throughout the region.

The numerical rank of some of the mosquitoes found in the Missouri Valley region of Nebraska as compared to the state as a whole was as follows, the rank for the state, based on Tate and Gates, being given in parentheses:

1. *Aedes vexans* (1); 2, *Culex pipiens* (8); 3, *Culex tarsalis* (2); 4, *Psorophora ciliata* (17); 5, *Aedes nigromaculis* (5); 6, *Psorophora discolor* *; 7, *Culex restuans* (10); 8, *Culex salinarius* (7); 9, *Anopheles punctipennis* (12); 10, *Aedes trivittatus* (9).

It is interesting to note this lack of conformity between the two lists. Tate and Gates had their light traps spread over the entire State and their data shows a pattern representative of the grassland areas, but not of the deciduous forest area.

The use of light traps alone tends to give a misleading picture. This is well illustrated by the fact that *Psorophora ferox* and *P. horrida* were never taken by light trap whereas they were readily taken in biting collections. Also, larval collections indicate the presence of species not readily attracted to light or to man.

Summary. A total of 25 species were collected in the Missouri Valley region of Nebraska during the summer of 1952. The following four species made up 84 percent of the mosquito population: *Aedes vexans* 63 percent, *Culex pipiens* 10 percent, *Culex tarsalis* 8 percent, *Psorophora ciliata* 3 percent. Two of these species are important vectors of encephalitis; *C. pipiens* is considered the prime vector of St. Louis encephalitis and *C. tarsalis,* the prime vector of western equine encephalitis. In spite of the fact that spring floods left many pools of standing water on the lower flood plain of the Missouri River, large mosquito populations were not found. This may be explained by the fact that most of the pools of flood water had dried up by the middle of July.

* Not listed by Tate and Gates.

Bibliography

Tate, H. D. and Gates, D. B. 1944. The mosquitoes of Nebraska. University of Nebraska, College of Agriculture. Research Bulletin 133: 1–27.

Rapp, William F., Jr. 1955. *Culex tarsalis* and the Grassland Biome. Proceedings and Papers of the 23rd Annual Conference of the California Mosquito Control Association and the American Mosquito Control Association, pp. 89–90.

NOTES AND DISTRIBUTION OF *AEDES* MOSQUITOES IN PANAMA BASED ON A THREE YEAR LIGHT TRAP SURVEY[1]

FRANKLIN S. BLANTON[2] AND E. L. PEYTON[3]

This paper represents the third of a series of small papers on the distribution of Panama mosquitoes based on light trap operations conducted by the 25th Medical Detachment during 1951 to 1953 inclusive.

In Panama there are no diseases known to be transmitted by any member of this genus at this time; however, it is a well known fact that *Aedes aegypti* has been responsible for the transmission of the yellow fever virus. In all of our surveys conducted from Colombia to Costa Rica from 1951 to 1953 inclusive not a single *Aedes aegypti* has been collected. One would not expect many from light traps as they are not readily attracted to light. No larvae were taken in any of our surveys, but with the exception of a few villages near Panama City and Colon, larva collecting was not extensive. The species may or may not be present in the Republic of Panama but the writers feel that limited populations may still be present in the more remote villages. This is a very different picture from that of a few years ago when this dangerous vector of "Yellow Jack" was so prevalent in many areas of Panama. Much of the credit for the elimination of this species from Panama goes to Dr. Pedro Galindo of the Gorgas Memorial Laboratory who was formerly Entomologist for the Public Health Department of the Republic of Panama and his assistant Mr. Gallardo who is now the Entomologist of the Republic of Panama. Other *Aedes* species such as *terrens, leucocelaenus,* and *leucotaeniatus* that live in the deep forest and have the same ecological habits as the genus *Haemagogus* may or may not be vectors of jungle yellow fever. Members of this genus have been incriminated as vectors of dengue, yellow fever and jungle yellow fever and some of the encephalitides.

In Panama the writers have taken females of some *Aedes* species with bot-fly eggs attached. They evidently play a part in dermatobiasis to both man and probably to cattle as well as smaller mammals.

As pests, the genus *Aedes* has probably been as annoying as any genus. Salt marsh mosquitoes, *Aedes taeniorhynchus* and *Aedes sollicitans* on our Atlantic Coast have been troublesome during the entire history of the United States. Now that resistance to DDT has been encountered in several places in the United States, older methods of control such as drainage and filling may become necessary. In Alaska the senior writer has experienced extreme annoyance from *Aedes* and this has also been true for many of the Pacific Islands.

In Panama, prior to the installation of tide gates at the Farfan River spillway, *Aedes taeniorhynchus* breeding in Farfan Swamp and Fort Kobbe Swamp literally made life unbearable for residents of Fort Kobbe. This species is very troublesome at times in many areas in Panama but on the whole the genus *Mansonia* in Panama is probably more troublesome than *Aedes*.

The following 9 species of *Aedes* have been taken in Panama by our light traps, and Dr. Galindo has collected two additional species that are new to Panama: ***angustivittatus, euplocamus, fulvus, hastatus, leucocelaenus, septemstriatus, serratus, taeniorhynchus, terrens.***

[1] The writers wish to acknowledge the help of Dr. Pedro Galindo of the Gorgas Memorial Laboratory who has aided the authors in all taxonomic phases of our studies of Panama mosquitoes.

[2] Lieutenant Colonel, MSC, formerly Entomologist, U. S. Army Caribbean, Fort Clayton, Canal Zone, now with the Army Medical Service Research and Graduate School, Walter Reed.

[3] Sergeant, First Class, Preventive Medicine Technician, formerly with the 25th Medical Detachment, Fort Clayton, Canal Zone, now with the 6th Army Area Laboratory, Fort Baker, California.

Other species taken in Panama by other methods are as follows: *aegypti, fluviatilis, hortator, leucotaeniatus, quadrivittatus, sexlineatus.*

This represents a total of 17 species of *Aedes* in Panama and the writers believe that there are two or three species in the *terrens* complex. A key has been prepared but the genus is in need of a complete revision and our key would be misleading to those not familiar with the Panama species. Specimens may be placed in the correct genus by use of the pictoral key prepared by Peyton, *et al.* (1955).

The provinces and towns as well as the species encountered are listed alphabetically. The number of specimens taken at a given time are in parenthesis.

The distribution is as follows:

Aedes angustivittatus (Dyar and Knab), Jour. N. Y. Ent. Soc. Vol. 15, p. 9, 1907. **Bocas del Toro:** Almirante, 6–27 Jan. (21); 15 Apr. (1); 15–26 Nov. (48); 3–16 Dec. (17). **Canal Zone:** Fort Kobbe, 17 July (1); Loma Boracho, 10 Jan. (4); 12 May (2); 17–29 Oct. (2); Loma Boracho, Position 9, 19–23 June (12); 7–17 July (16); Madden Air Strip, 9 Oct. (29); Mandinga River, 25 Apr. (3); 15 May (2); Mindi Dairy, 3 Dec. (1); Mojinga Swamp, 3 Jan., (1); 7 May (1); 17 June (2); 8 Nov. (1); Tarpon Club, (Atlantic Side 16 Oct. (1). **Cocle:** Anton, 11 Nov. (11); Chiru, 10 Nov. (6); La Venta, 8 Nov. (4); Port Of Farallon, 8–9 Nov. (172); Port Obaldia, 11 Nov. (4); Rio Hato, 8–9 Nov. (17); Villa Real, 12 Sept. (2). **Darien:** El Real, 8 Aug. (1). **Panama:** Bayano, 8 Apr. (1); Camaron, 23 June (2); 17 July (1); El Coco, 10 Sept. (1); Juan Diaz, 24 Sept. (2); La Chorrera, 8 Sept. (21); Neuva Gorgona, 16 Sept. (2); Old Panama, 26 Sept. (1); Pacora, 27 Jan. (3); Palm Beach, 17 Sept. (6); Rio Las Lajas, 17 Sept. (2); Tocumen, 5–29 Jan. (25); 4–13 Feb. (36); 29 Sept. (4); 19 Dec. (1). **Veraguas:** El Maria, 14 July (1); Sapotilla, 14 July (5).

Aedes euplocamus (Dyar and Knab), Jour. N. Y. Ent. Soc. Vol. 14, p. 190, 1906. **Bocas del Toro:** Almirante, 5–26 Jan. (4); 12–26 Nov. (24); 1–15 Dec. (5). **Canal Zone:** Mojinga Swamp, 27 Nov. (1).

Aedes fulvus (Wiedemann), Auss. Zweifl. Ins., 1:548, 1826. **Bocas del Toro:** Almirante, 11–24 Nov. (4). **Canal Zone:** Fort Sherman, 9 June, (1); Loma Boracho, 18–26 June (231); 2–22 July (128) 17–29 October (4); Loma Boracho, Position 9, 19–23 July (32); 7–24 July (29); Mojinga Swamp, Station 1, 25–30 June (50); 10–28 July (57); Mojinga Swamp, Station 2, 1–15 July (12); 29 Oct. (1); 20 Nov. (1); Mojinga Swamp, Station 4, 21 May (1); 17–24 June (18); 9–23 July (36). **Darien:** Garachine, 19 Feb. (1); Patino Point, 16–27 July (4); 14–17 Aug. (3). **Panama:** Arraijan, 2–14 Aug. (9); La Jolla, 25 June (2. The writers collected the larvae of this species on the Atlantic side of the isthmus, which represents the first collection for Panama. Another paper is planned on this species with descriptions of the larvae.

Aedes hastatus (Dyar), Insec. Inscit. Vol. 10, p. 160, 1922. **Bocas del Toro:** Almirante, 5–27 Jan. (227); 2 Feb. (1); 10–26 Nov. (211); 1–15 Dec. (19). **Canal Zone:** Loma Boracho, 18–27 June, (4); 29 Oct. (4); Loma Boracho, Position 9, 8 May (1); 11–23 June (24); 7–24 July (24); Madden Dam, 27 June (1); Mojinga Swamp, 7 Feb. (10); 7–14 May (5); 17 June (1); 8–28 Nov. (2); 10 Dec. (1). **Cocle:** Anton, 11 Nov. (2); Chiru, 10 Nov. (6); Port of Farallon, 8–9 Nov. (24); Port Obaldia, 11 Nov. (2); Rio Hato, 8–9 Nov. (5). **Darien:** Jaque, 11 Aug. (1). **Panama:** Alcalde Diaz, 10 Oct. (1); Arraijan, 24 June (1); Camaron, 23 June (3); 22 July (1); La Jolla, 23 Sept. (7); Naranjal, 1 Oct. (1); Nueva Gorgona, 16 Sept. (2); Palm Beach, 17 Sept. (1); Tocumen, 6–29 Jan. (2).

Aedes leucocelaenus (Dyar and Shannon) J. Wash. Acad. Sci. Vol. 14, p. 484, 1924. **Bocas del Toro:** Almirante, 12 Nov. (1). **Canal Zone:** Madden Dam, 21 Sept. (1).

Aedes septemstriatus (Dyar and Knab), J.N.Y. Ent. Soc. Vol. 15, p. 10, 1907. **Bocas del Toro:** Almirante, 11 Dec.

(2). **Canal Zone:** Mojinga Swamp, 21 July (1).

Aedes serratus (Theobald), Mon. Cul., 2:45, 1901. **Bocas del Toro:** Almirante, 5–27 Jan. (68); 10–26 Nov. (254); 1–16 Dec. (92). **Canal Zone:** Fort Clayton, 18 June (1); Fort Kobbe, 26 June (8); Loma Boracho, 18–26 June (14); 29 Oct. (14); Loma Boracho, Position 9, 10 Jan. (3); 19–23 June (52); 2–8 May (6); 2–24 July (15); Madden Dam, 27 June (1); Mandinga River, 15 May (1); Mindi Dairy, 3 Dec. (2); Mojinga Swamp, 27 Feb. (1); 16 Apr. (2); 7–13 May (3); 17–30 June (15); 9–15 July (4); 15 Aug. (1); 29 Oct. (1); 15–20 Nov. (3); 10–12 Dec. (4). **Chiriqui:** Boquete, 15 Dec. (1); El Volcan, 6–9 Dec. (6). **Cocle:** Anton, 9 Dec. (1); Aguadulce, 25 Sept. (24); Chiru, 10 Nov. (2); El Retiro, 10 Nov. (4); Espino, 18 Sept. (1); La Venta, 8 Nov. (3); Port of Farallon, 8–9 Nov. (153); Port Obaldia, 11 Nov. (4); Rio Hato, 24–26 Sept. (14); 8–9 Nov. (55); Salado, 12 Nov. (1); Villa Real, 12 Sept. (2). **Darien:** El Real, 8 Aug. (1); Garachine, 19 Feb. (1); Jaque, 27–28 July (6); 11 Aug. (10). **Herrera:** Ocu, 25 Nov. (1); Paris, 23 Oct. (3); Parita, 23 Oct. (1); Pese, 22 Oct. (1). **Los Santos:** Las Palmas, 26 Oct. (1); Port Mensabe, 22 Oct. (1). **Panama:** Camaron, 23 June (2); 17 July (18); Cermeno, 11 Sept. (1); Juan Diaz, 24 Sept. (1); La Chorrera, 8 Sept. (4); La Jolla, 6 Mar. (2); 26 June (2); 31 Aug. (5); 7–23 Sept. (44); 5 Oct. (6); Pacora, 29 Sept. (2); Palm Beach, 17 Sept. (1); Rio Las Lajas, 17 Sept. (1); Tocumen, 5–29 Jan. (9); 4–19 Feb. (5); 17 Nov. (1); 20–21 Dec. (4); Vique Cove, 7 Oct. (2).

Aedes taeniorhynchus (Wiedemann), Dipt. Exot., 1:43, 1821. **Canal Zone:** Albrook Field, 19 June (13); Fort Clayton, 1 July (13); 22 Sept. (1); Fort Davis, 11 May (6); Fort Kobbe, 17–26 June (567); 21 July (2); 7 Oct. (6); Fort Sherman, (Devils Beach), 28 June (2); Fort Sherman, (French Canal) 8 Apr. (1); France Field, 22 Apr. (5); Galeta Island, 26 Aug. (1); Loma Boracho, 18–26 June, (4); 22 July (1); 29 Oct. (1); Loma Boracho, Position 9, 12 May (26); 19–23 June (41); 7–17 July (9); Madden Dam, 27 June (11); Mandinga River, 11 May (2); Mindi Dairy, 12 June (13); Mojinga Swamp, 13–15 May, (17); 17–25 June (8); 15–21 July (3); Tarpon Club, 18 Apr. (2). **Cocle:** Aguadulce, 7 Aug. (62); 25 Sept. (98); Anton, 11 Nov. (5); Chiru, 10 Nov. (56); El Espino, 18 Sept. (16); El Retiro, 10 Nov. (36); La Venta, 8 Nov. (6); Port of Aguadulce, 21 Nov. (1); Port of Farallon, 8–9 Nov. (864); Rio Hato, 15 Jan. (6); 25–27 June (71); 3 Aug. (1); 24–26 Sept. (70); 8–9 Nov. (9); Salado, 12 Nov. (3); Villa Real, 12 Sept. (7). **Colon:** Pina, 18 Aug. (1). **Darien:** Garachine, 19–25 Feb. (615); Jaque, 24–28 July (77); 10–12 Aug. (5); Patino Point, 22–23 June (18); 1–21 July (444); 4–31 Aug. (101); 1–30 Sept. (257). **Herrera:** Chitre, 8 Aug. (1); Parita, 23 Oct. (6); Port of Chitre, 24 Oct. (5). **Los Santos:** Guarare, 23 Oct. (1); Las Tablas, 14 June (3); Los Santos, 24 Oct. (1); Port Mensabe, 22 Oct. (3); Santo Domingo, 26 Oct. (1). **Panama:** Arraijan, 26 Mar. (8); 7–8 Apr. (242); 24 June (124); 2 Aug. (2); 7 Oct. (2); Camaron, 23 June (285); 17–22 July (29); 17 Oct. (20); Cermeno, 11 Sept. (3); El Coco, 10 Sept. (4); Juan Diaz, 24 Sept. (5); La Chorrera, 8 Sept. (37); Nueva Gorgona, 16 Sept. (37); Old Panama, 26 Sept. (55); Pacora, 29 Sept. (1); Palm Beach, 17 Sept. (27); Pena Blanca, 9 Sept. (13); 27 Oct. (1); Port of Chorrera, 9 Sept. (68); Port Obaldia, 11 Nov. (50); Venado Beach, 28 July (8); Vique Cove, 7 Oct. (12).

Culex terrens (Walker), Ins. Saund., 429, 1859. **Bocas del Toro:** Almirante, 12–20 Jan. (2); 24 Nov. (2); 1–11 Dec. (5). **Canal Zone:** Fort Kobbe, 24–28 Aug. (2); 17 Oct. (1); Fort Gulick, 21 Aug. (3); Loma Boracho, 29 Oct. (4); Mojinga Swamp, 15 May (1); 28 Aug. (1); 5 Sept. (1); 29 Oct. (1); 19 Nov. (7). **Panama:** La Jolla, 26 June (1).

SUMMARY. This is the third of a series of small papers on the distribution of Panama mosquitoes based on light trap surveys conducted in Panama by the 25th

Medical Detachment, during 1951 to 1953 inclusive. *Aedes aegypti,* the classical vector of yellow fever has not been collected for some time. The scope of this paper included only adults; however it is noted that the larvae of *Aedes fulvus* were collected for the first time in Panama during the period of these studies. Other species of *Aedes* may or may not be responsible for the transmission of jungle yellow fever in Panama as well as *Haemagogus* spp.

The distribution of those species taken in our light traps is given. To date nine species have been taken in our light traps and six additional species by other means. Dr. Galindo, of the Gorgas Memorial Laboratory, has collected two more species that are not listed from Panama. This makes a total of 17 known species in Panama and there are additional species in the *A. terrens* complex.

Literature Cited

Peyton, E. L., Galindo, Pedro and Blanton, Franklin S. Pictorial keys to the genera of Panama mosquitoes. Mosquito News. 15(2):95–100, 1955.

HARRY SETS THE STAGE AGAIN

A charter member of the American Mosquito Control Association, its President in 1947, National Adviser, 1949–1954, Associate Editor of and frequent contributor to *Mosquito News,* sponsor of the Good Neighbor Club—few persons have contributed as much of time, talent and enthusiasm to the Association as Harry Stage, or have been more zealous in the furtherance of its aims. Now, in addition to all this he becomes our first Life Member. This fine gesture of interest and confidence should be an inspiration to the Association.

(Life Member—Any member may become a life member of the Association upon payment to the Treasurer of $100.00 in a lump sum, and thereafter shall be exempt from any further payment of dues.

Life members shall receive MOSQUITO NEWS, enjoy the same privileges, and carry the same responsibilities as members of the Association.)—From the Membership Application Blank.

NEWS AND NOTES

AUSTIN W. MORRILL, JR.

THE ANNUAL MEETING OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION was held in Fresno on 27, 28 and 29 January and was attended by nearly 300 persons, including quite a number from other states. Among those from Utah attending this 26th annual conference, for instance, were GLEN COLLETT, ARCHIE HESS, JAY GRAHAM, LOUIS OGDEN. HARRY STAGE, GAINES EDDY and C. M. GJULLIN represented, we guess, Oregon, though each of them is such a globe trotter that we hardly know *what* to call *their* home base. C. M. GJULLIN, for instance, enlivened several talk fests with information on how mosquito control in going in Taiwan, from which he recently returned, and where he reviewed the good work of DON PLETSCH, for which Bro. Gjullin had some glowing praise. To get back to the meetings, besides a large number of excellent and informative papers on various control subjects, which will be available in the proceedings, there was a provocative and thoughtful summation of the insecticide resistance problem, by BOB METCALF, accompanied by beautiful slides he had taken on his recent visit to WHO Headquarters in Switzerland; an also stimulating account of a recent trip to review public health in Russia, by Dr. Malcolm Merrill, Director of the California State Department of Public Health; and a lively symposium on the control of mosquitoes when we aggravate the problem by changing their environment, led by DR. STANLEY FREEBORN, Provost of the University of California at Davis, etc. Stan also pitched in at the last moment and doubled for the main speaker at the banquet on a moment's notice, and delivered such an interesting and witty address that he was given a real ovation and everyone was still talking about it the next day. How many banquets can you remember saying *that* about?

BOB PORTMAN was elected President of the C.M.C.A., GORDON SMITH is the new Vice-President and ED WASHBURN, our perennial and hard-working Secretary and Treasurer was reelected to those posts. One way to be reelected permanently, ED, is to be competent, as we keep warning you.

NOBODY, BUT NOBODY EVER TELLS US ANYTHING and if we hadn't been pretty quick on the draw at Fresno and made people stop and back up and amplify things they made passing reference to, we *still* wouldn't know that BARNEY TRAVIS is in Manila on a 2-year leave from Cornell; FRANCISCO DY *does* have a more exalted title now (we brought you this bit of news prematurely some time back and had to correct it because we'd heard the title sort of mixed-up like, but you see we *do* have a nose for news, and we only hope our scoop didn't endanger this well-merited promotion even for a little); RUSS FONTAINE is going to Ethiopia shortly as Principal Consultant in Malaria in the ICA mission, to stay no more than 2 years under pain of Dick Peters' having a stroke if he does overstay; and MARV KRAMER is leaving the Alameda Mosquito Abatement District (with regrets all round) to return to his earlier field as Water Projects Consultant to the California Bureau of Vector Control, Marv having had this function with the U.S.P.H.S. in the Mississippi River Basin. We've sent an air letter to Dr. Dy and asked him to phone Barney for us, too, and got off a quickie plea to Russ for more news, so if they come through we'll add more to all this later.

SPEAKING OF UTAH, a moment ago, reminds us that the Utah Mosquito Abatement Association meetings were held on March 14 and 15, at Ogden, according to Glen Collett. And reminds us too that one of the highlights of the California meetings was a paper on the feeding habits of *Gambusia affinis* in Utah, by DR. BRYANT E. REES, who is a nephew of DON REES, and a professor at Fresno State College.

MOST OF US READ A GOOD DEAL ABOUT THE CELEBRATION OF THE 350TH ANNIVERSARY OF THE FOUNDING OF JAMESTOWN, VIRGINIA, WHAT WITH QUEEN ELIZABETH VISITING IT AND ALL, but probably we were about the only people in America who knew what lay behind the fact that none of the accounts mentioned anybody, let alone the Queen, being eaten up by mosquitoes. V.M.C.A.'s *Skeeter* for November and December reports that the Commissions of Hampton, Warwick and York Counties were responsible for control of a difficult area of many square miles and that in conjunction with this 10-year program of basic environmental control the Williamsburg Commission fogged the spectator area of their famous historical pageant every night.

SKEETER ALSO DESCRIBES IN THE SAME ISSUE, A HOMEMADE GADGET FOR HELPING THE TECHNICIAN AT THE MICROSCOPE TO MANIPULATE THE MOSQUITOES HE'S IDENTIFYING. "It was found," the article says, "that by mounting a 2 inch by 3 inch pocket mirror at the right height and distance in front of the instrument, the eyes could see a reflection of the whole working platform from the same position required to use the microscope. Of course, the image is reversed, but so is the image when one shaves in front of a mirror each morning." (But of course, one doesn't care to see *that* image too clearly, Rollie!)

"Also, covering the glass top of the platform with a white card reduced slip and made handling

easier," the article continues. "And putting a 'V' shaped trough on its front edge with the small end pointed to the field of vision helped to channel insects more readily to the proper spot. Thus the work has been speeded up and headaches avoided at the cost of only a few cents—and no patents involved."

From Don Rees Himself, in Indonesia, Comes a Note Which We Reproduce Below, and word that he is giving two one-hour lectures a week and directing two laboratory periods a week in medical entomology to 158 third-year medical students. Don says his greatest problem is getting arthropod laboratory specimens of the various groups of medical importance and in quantity sufficient for so many students. Don's note:—

"On November 13th, a tour of inspection was made of the new quarters of the Department of Parasitology and General Pathology of the University of Indonesia in Djakarta. The tour was made at the invitation of Professor Lie Kian Joe, Department Head. The building is air conditioned, spacious and much of the interior finished in white tile. In addition to offices, class rooms, laboratory, research and store rooms, it has a museum, animal quarters and a nursery to care for the children of mothers employed in the department. Ample space and facilities have been provided for teaching and research in medical entomology. Work in this field is required as part of the training of medical students in the Universary of Indonesia. Following the tour a meeting was held in which representatives of the various departments and agencies interested in arthropod borne diseases decided to meet each month in a seminar. The first seminar was held in the auditorium of this new building on January 13, 1958. A large group attended this meeting, where papers on malaria control, malaria eradication and on filariasis in Indonesia were presented and discussed. The enclosed picture was taken in the medical entomology laboratory by Edgar A. Smith at the November meeting."

And One of Our Navy Mosquito Control Men Sends in the Information that a Requisition He Made Out for Insecticide was identified in his office as being intended for "Larva seeding." Any more ideas, anyone?

Speaking of the Entomological Society of America Meetings in Memphis, President Art Lindquist Writes, "Every AMCA member should be proud of the fine exhibit. . . . Hundreds of people stopped to view the exhibit for varying lengths of time and were observed to pick up and take along information literature. This exhibit did much to acquaint entomologists of ESA with the aims and accomplishments of the AMCA. We owe a great deal to George Hutton, chairman of the committee which prepared the excellent exhibit, and to the committee members, and others who manned the booth, especially Mr. William M. Cox of Galveston, Texas."

Photo by E. A. Smith

Bottom row, l. to r. H. T. Soeparmo, H. Smetana, D. M. Rees, E. Dresner, L. Hines. *Top row, l. to r.* K. J. Lie, T. Sutomo, J. M. Edney, R. L. Laird.

HARRY STAGE, A.M.C.A.'s UNOFFICIAL INTERNATIONAL REPRESENTATIVE and roving member-at-large, who usually sends us news from Patagonia to Siberia, sends a note on his own State of Washington, which is mighty interesting. The first meeting of a mosquito control district board of trustees in the State of Washington occurred when the Benton County Mosquito Control District board met on December 3, in Pasco, Harry says. DR. ROBERT C. PENDLETON, biologist and a member of AMCA, was elected President. The district is not county wide, as yet, and the first meeting of a county wide mosquito control district in Washington was on December 9, when the Adams County MCD met in Lind. The enabling act permitting these and five other counties in the Columbia Basin, was passed by the State Legislature last March. When our International Rep concentrates all that energy he has onto a sub-National level, things really start flying! In addition, he brought in two new AMCA memberships, one in the name of the Board of Trustees of the Adams County district and one for MR. ROGER JAMES, District Engineer, Washington State Department of Health, in Spokane. Welcome to AMCA!

J. F. SHARP SENDS US FROM OTTAWA AN ARTICLE ON THE RETIREMENT OF OUR EX-PREXY, C. R. TWINN. It is too long to reprint here, but summarizes Dr. Twinn's long and productive career, not overlooking mention of his faithful service to the cause of mosquito control and to A.M.C.A. We wish we'd had half as much info on our man back in 1955, when we ran a brief biography in *News and Notes* (Vol. 15, No. 1). We didn't know, for instance, that he had received the Coronation Medal in 1953 or that the Veterinary and Medical Entomology Unit (formerly Household and Medical Entomology Unit), which he had headed since its formation, has five laboratories stretching across Canada. Dr. and Mrs. Twinn plan to make their home at their woodland residence at Alexander Bay, Quebec, but were slated first to take a long winter vacation in Florida. The article ended, perceptively, ". . . it is unlikely that Dr. Twinn will remain for long entirely away from his entomological interests." An understatement, and one which we hope will apply to his interest in AMCA as well.

ACCORDING TO *California Vector Views* THE ILLINOIS MOSQUITO CONTROL ASSOCIATION held its annual meeting on 6 and 7 February at the University of Illinois in Urbana. Any comments? Well, from the same source, we see that the annual meeting of the NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION was 12, 13 and 14 March, at the Haddon Hall in Atlantic City. Doesn't Florida have a meeting? Maybe these notes ought to go to the Advertising Department, anyway. *What?* We can't quite hear you!

Vector Views ALSO HAS, IN ITS DECEMBER AND JANUARY ISSUES, TWO ARTICLES OF WIDE INTEREST which you may want to get for your own perusal. One is an excellent analysis of the Annual Report, something we all face now and then, and its positive uses as a means of public information and evangelization. The other article, by BEN KEH and MARV KRAMER, reports on an unusual *Chaoborus* infestation which occurred in Alameda County. These gnats, similar in their aquatic origins and bearing some general resemblance to mosquitoes, are causing many people in mosquito control a good bit of trouble because not only of the actual nuisances which they are but also because they stir the citizenry up to think that mosquito control is falling down. Ben and Marv got good control, you bet.

GEORGE BURTON, WHO IS BACK IN THE STATES ON LEAVE FROM NEPAL and is whiling away the idle hours brushing up on a spot of Hindi and Urdu (that's a language), has had a one-man show of his paintings, which featured portraits of tribesmen and general citizens and landscapes of Nepal and Tibet and particularly of the scenery around Katmandu, which some of you may have seen some months ago featured in the National Geographic. George's paintings were exhibited by the Department of Health, Education and Welfare for about three weeks and then went on view at the Middle East Institute for another week.

AS A STARTER ON OUR WHO'S WHO FOR 1958 WE HAVE A GENT WHOM MANY OF US THINK OF VAGUELY AS SORT OF A CANADIAN THOUGH HE'S BEEN A U. S. CITIZEN FOR A GOOD MANY YEARS and is a devoted "Westerner" as well. He was born in Scotland but came to America (Canadian North America, that is) before he was twenty. After serving in the Canadian Army during W.W. I, he received his B.S. in Agriculture from the University of Alberta, was a teaching assistant at the University of Montana, received his M.S. from the University of Minnesota and returned to teach at Montana for nearly ten years. He has supervised laboratories in Canada and the United States and is presently with the water projects section of the U. S. Public Health Service laboratory at Logan, Utah, under Archie Hess. He is a fellow of the American Association for the Advancement of Science, a member of the Entomological Society of America, of Sigma Xi and of Gamma Alpha. Though he is known to bicycle madly about town in Bermuda shorts, his real hobby, after fishing, is photography. With two teen-age youngsters, he may be slowing down a bit so as to dig in his heels now and then the way the rest of us have to do, but he doesn't give any indication of it. Who are we talking about? *You* know! ALLEN MAIL.

BESIDES MO, THE NAVY ALSO HAS A NUMBER OF OTHER WELL KNOWN ENTOMOLOGISTS ENGAGED IN MOSQUITO CONTROL AND WE'D LIKE TO BRING

You Three of Them Now. We've already told you about Capt. Ken Knight, of the Bureau of Medicine and Surgery in Washington, D. C. (Vol. 16, No. 1). Cdr. R. T. Holway, whom we welcomed to A.M.C.A. and to the Naval Air Station, Alameda, California, in the December issue, came here from Pearl Harbor, T.H., and before that he was in the Bureau of Medicine and Surgery, where he did much to further the Navy's control program. Before that, he was in Cairo . . . but perhaps we'd better begin at the beginning. Dick was born in 1911 in Boston, Massachusetts, and attended High School in Duxbury, a community south of Boston. Dick got his B.A. at Dartmouth and his M.S. at the University of Massachusetts, studying afterward at Harvard and then returning to U. of M., where he received his doctor's degree in 1937. He didn't have long to enjoy it before Uncle Sam put him into the blue uniform he has distinguished ever since in many places. Beginning with a malaria control unit at Camp Lejeune, he went on to Guadalcanal and other South Pacific islands where for some reason or other a lot of people seemed to be going right then. Afterward he returned to the Philadelphia Navy Yard, was in the Naval Medical Research Unit No. 3 at Cairo, Egypt, entomologist of Preventive Medicine in the Bureau of Medicine and Surgery, as we said, Preventive Medicine Unit No. 6 and now the Twelfth Naval District. His charming wife is from New Zealand and they have four daughters, which puts them a little behind in the overall Naval entomological picture. Dr. Holway's hobbies were sailing, skin diving and photography but the skin diving in San Francisco Bay probably will fall a little below the standards of Lanikai, Hawaii, we fear.

Capt. John D. DeCoursey is another Naval medical entomologist, whom many of us first knew as a research worker in the control field for the old Bureau of Entomology and Plant Quarantine, when he was stationed at Beltsville, Md. He left there, though, in 1941 to enter the Navy and do what he modestly cloaks under the inclusive title of malaria and mosquito control. From 1946 to 1950, he too was in the Bureau of Medicine and Surgery in Washington, and then went to the Naval Medical Field Research Laboratory at Camp Lejeune to head the Entomology Department. His next tour was at NAMRU 3 in Cairo and he is now at the Naval Medical School, National Naval Medical Center, Bethesda, Md. We forgot to mention John was born in Indianapolis in 1905, took his B.A. at Louisiana State and his M.A. and Ph.D. at the University of Illinois, where he studied under *Mosquito News*' Dr. Robert Glasgow.

Another Distinguished Member of Our Naval Mosquito Control Club Is Cdr. Bob DuChanois, (otherwise Francis R.). Bob is presently the Officer in Charge of Preventive Medicine Unit No. 1 at the Naval Air Station, Jacksonville, Fla., where quite a bit of the military testing and training of mosquito control equipment and personnel has been done of late. Previously, however, he received his B.Sc. from Colorado A. and M., his M.S. at Iowa State College and completed his Ph.D. requirements at the same institution. Between the first and second degrees, however, he had been with the U. S. Department of Agriculture and had several Naval assignments, including the malariology school at Bethesda, Md., the Naval Air Station at Corpus Christi, Texas, the School of Environmental Sanitation, which is in Oakland, California, the USDA lab at Orlando, and P.M.U. No. 6 in Pearl Harbor, Hawaii. Bob has five children and listed them as his hobby, along with insect and stamp collecting and reading but we notice that he left off the reading on the last revision of his form we received, and we have an idea that it will remain a minor engagement with him until the baseball and scouting phases get safely past. Along about the end of high school, Bob, we usually get back to our reading, to keep from biting our nails over whether they're all right in That Car.

While We're on the Military, There's Another One Whose Name Has Appeared a Good Bit in *Mosquito News* and Whom You'll Likely See at the Washington Meetings. He was born in Sandusky, Ohio, in 1918 and received his B.Sc. from Ohio State and then came to Maryland for his Master's. Much of his duty has been in the Orient, in military malaria control in Burma and China and Okinawa, with stops in the Military District of Washington (D. C.) and the Second Army Medical Laboratory in Ft. Meade, Md., to refresh him on his English language. Then he was Chief of Entomology at the Army's 406th Medical General Laboratory in Tokyo for quite a spell and is now at the Environmental Health Laboratory at the Army Chemical Center, Maryland. It's Ted Blakeslee we're talking about, and he was a Major last we heard, which isn't the last we *will* hear, we're sure.

Dr. Dy Came Through With An Answer by Return Airmail (we wish everyone would do that!) confirming that he is now Director of Health Services of the WHO Regional Office for the Western Pacific, and he adds, "Malaria eradication is a priority programme in our Region as it is in other parts of the world, and we hope to be able to strengthen our malaria eradication unit at the Regional Office to provide more effective and expeditious assistance to governments in the Region." He says, too, that Barney Travis is at the College of Agriculture, Los Baños, Laguna, a beautiful campus some thirty miles south of Manila overlooking Laguna de Bay. Among its other attractions, the School of Forestry maintains there an extensive arboretum of tropical plants, among whose orchid-draped groves there nestles a pavilion and picnicking area which is a favorite memory of ours. Wish we could have

an AMCA picnic there with you, Barney! *Mabuhay!*

THE NORTHEASTERN MOSQUITO CONTROL ASSOCIATION held its fourth annual meeting on January 30 and 31, 1958, at the Waltham Field Station, Waltham, Mass. It was attended by about 70 members or other persons interested in mosquito control problems.

The program included panel discussions on recent developments in insecticides and methods of adult mosquito control. Other subjects of papers and discussion were: eastern equine encephalomyelitis in Massachusetts and Connecticut, mosquito control and wildlife, nuisance insects other than mosquitoes, insecticides residues on agricultural products and their relation to mosquito control, and public relations for mosquito control commissions.

The following officers were elected for 1958–59: president, Lewis Wells; vice president, Hugo Jamnback; secretary-treasurer, John Kuschke; and Executive Board member for three years, Robert Heaton.

GUATEMALA CITY, the city of eternal spring in Central America, recently was the meeting place for a dozen or so AMCA members from various countries. There assembled, to participate in the first English language international course in malaria eradication techniques ever held in the Western Hemisphere, were these members, present either as "visiting professors" or "students." This historic event, consisting of a twelve-week course, was sponsored by the Pan American Sanitary Bureau.

Dr. Firmino de Oliveira Lima was the course director, with assistance from Dr. Louis L. Williams, Dr. Harry Pratt, George Bevier, Larry Hall, Don Pletsch, Don Johnson, and a number of other persons long associated with malaria programs. The student list included old friends, such as Russell Fontaine, Carlton D. Gilkes, Pantelis Milous, T. A. Omardeen, and Dr. M. Sta. Maria.

Rumor has it that the next twelve-week course starts in May, but will be moved to the delightful island of Jamaica under joint sponsorship of PASB and ICA. Sorry fellas, you gotta be sponsored by WHO, PASB, or ICA to get in on this deal. Just so happens that lots of our members are attached to the malaria eradication programs of those organizations.

INFORMATION WANTED

What is the best way to determine the amount of dust actually applied, i.e., that actually comes to rest, per unit area of surface, from aircraft? Cards treated with an indicator dye are in common use for registering liquid (spray) deposits. What about dusts? Coated plates? If so, what to use? Bob Armstrong asks the question; many others also want to know; who has the answer, or a suggestion?

REVIEWS AND ABSTRACTS

Expert Committee on Insecticides, Seventh Report. World Health Organization Technical Reports Series, 1957, No. 125. 31 pp. Price: 1/9, $0.30, Sw.fr.1.—. Available in English, French, and Spanish. Columbia Univ. Press, International Documents Service, 2960 Broadway, New York 27, N. Y. The diseases transmitted by arthropods, and in particular the insect-borne diseases, constitute one of the most important problems with which national health administrations are confronted. The initial result obtained with modern insecticides gave rise to the hope that most of these diseases could be successfully controlled, and even completely eradicated, within a more or less short period. However, the resistance to chlorinated hydrocarbon insecticide which has appeared in various vector species, has somewhat changed this outlook. Resistance, which has developed much more rapidly than the measures available to combat it, at present represents the main obstacle in the fight against arthropod-borne diseases. Thus the Expert Committee on Insecticides devoted its 7th session more particularly to a study of the present problem of resistance and to pointing out the international measures called for.

Summarizing the present status of the question, the Committee's report stresses that resistance is now universal in the house fly, that it is frequently found in the louse and that it has been reported in various species of mosquito (*Anopheles, Aedes aegypti, Culex*) as well as in at least 27 other insect species. An inquiry by WHO with the aim of determining what research is under way on the resistance problem has shown the inadequacy of the work being undertaken in this field. The report indicates the broad outline of an international co-ordinated research program on resistance, which should include in particular the collection and diffusion of information, the promotion of research, the increase of personnel and financial means devoted to this work, the adoption of standard test methods, the testing of new insecticides, the establishment of satisfactory liaison between research workers and laboratories, and the convening of meetings and conferences.

The report adopts, with certain amendments, the definition of resistance formulated during the symposium on the Control of Vectors of Disease, held in Rome in 1953, and puts forward recommendations on the means to be used to detect and measure resistance. It discusses, in particular, the various applications of a standard test method, which would make it possible to obtain data on the appearance of resistant insect strains. It also mentions a certain number of problems connected with the biological aspects of resistance, which should be studied without delay.

A second part of the report, devoted to the disinsectization of aircraft, contains revised specifications for aerosols and aerosol dispensers accompanied by a description of suitable test methods, as well as new recommendations concerning the method of carrying out disinsectization for quarantine purposes.—WHO review.

Studies on the Incidence of Bancroftian Filariasis and the Natural Infection of Mosquitoes in Western Kyushu, Japan. II. On the Natural Infection of Mosquitoes. By Oshima, M. Jap. J. san. Zool. 7(1):9–18. 1956. (In Japanese, with references, tables, titles, and summary in English.) This is a report dealing with the natural infection of mosquitoes collected by various methods during the period 1951–1954 in 15 filarious villages in Western Kyushu, Japan. Of the 15 species (2431 individuals) of mosquitoes collected in human dwellings or by human-baited-trap and in cattle sheds, or by goat-trap at or near infested households, two species only, *Culex pipiens pallens* and *Aedes togoi* were found infected with filaria.

C. pipiens pallens is the most predominant and is attracted most to humans for feeding; its natural infection rate is the highest (41 in 1214, or 3.38%). *Aedes togoi* is common especially in the villages in the rocky coastal region, but is less numerous entering houses or cattlesheds than the other predominant species. It is no more attracted to humans than to cattle, and only one mosquito of 106 dissected was infected.

The other species collected were not infected. They were: *Anopheles hyrcanus sinensis, An. sineroides, Culex bitaeniorhynchus, C. pallidothorax, C. sinensis, C. tritaeniorhynchus, C. vishnui, C. vorax, Aedes albopictus, Ae. japonicus, Ae. vexans nipponii, Armigeres subalbatus,* and *Tripteroides bambusa*.—Excerpts from author's text and summary.

A Critical Review of the Techniques for Testing Insecticides. By J. R. Busvine. Commonwealth Institute of Entomology, London, 208 pages, 1957. — This important, authoritative, and lucidly written review and guide to the techniques for testing insecticides (up to the spring of 1957) should be read and studied by everyone with an interest in mosquitoes. Its great usefulness would be hard to overestimate for it is at once impartial, direct, and filled with an abundance of the most pertinent details, unusually functional illustrations, and an excellent bibliography of 551 references. Explanations of the abundant, and often complex, formulae are presented with admirable clarity. The chapter on toxicological statistics may well be a masterpiece. Although the book does not possess an index, the detailed table of contents and the arrangement of the 12 chapters are such that much information can be readily located. This reviewer, however, felt that a general and species index would have proved especially useful. The book is

attractively bound and nicely printed.—Jack Colvard Jones, N.I.H., Bethesda, Md.

THE OXIDATIVE ACTIVITY OF PARTICULATE FRACTIONS FROM MOSQUITOES. By Gonda, O., Traub, A., and Avi-Dor, Y. Biochem. Journal 67(3): 487–493. 1957.—The authors describe in some detail procedures for preparing mosquitoes for enzyme analysis (crushing in the cold, adding standard extraction medium, squeezing through gauze, centrifuging, washing, and suspension of cell particulates). Conventional Warburg techniques were used for measuring oxygen uptake.

From one gram of mosquitoes (*aegypti*) they obtained approximately 35 mg. of "respiratory" particles (mostly sarcosomes or mitochondria from thoracic muscles). Their paper shows that all of the citric acid-cycle intermediates (acetate, pyruvate, citrate, isocitrate, oxoglutarate, L-glutamate, reduced diphosphopyridine nucleotide, succinate, fumarate, L-malate, and oxaloacetate) are oxidized and that respiration is linked to phosphorylation. To obtain maximal oxidation they found it necessary to regulate the tonicity of the medium and to add protective agents (e.g., serum albumin). Undamaged particles (sarcosomes) required only adenosine triphosphate and magnesium ions, whereas injured particles needed phosphate, diphosphopyridine nucleotide, and increased amounts of both adenosine triphosphate, magnesium, and coenzyme A.

The authors state that phosphorylation is more affected by DDT than respiration. They do not stress the fact that this effect was observed with quite high concentrations of DDT (3×10^{-4} and 10^{-4}), nor do they mention whether acetone controls were performed with these experiments. It is unfortunate that they did not do so, for acetone alone readily and markedly decreases phosphorylation.—Jack Colvard Jones, N.I.H., Bethesda, Md.

PHYSIOLOGICAL EFFECTS OF CARBOHYDRATES IN THE NUTRITION OF A MOSQUITO, *Aedes aegypti* AND TWO FLIES, *Sarcophaga bullata* AND *Musca domestica*. By Galun, Rachel and Fraenkel, G. J. Cell. & Comp. Physiol. 50(1):1–23. 1957.—In this interesting paper the authors show that young adult *aegypti* females survive for long periods (39 to 67 days) when fed *ad libitum* at 28° C. on 5 percent solutions of the following sugars: glucose, fructose, sucrose, maltose, raffinose, melezitose, and sorbitol (all but the last two are found in nectars). The adults did not survive on xylose, arabinose, ribose, rhamnose, sorbose, cellobiose, inulin, *a*-methylmannoside, dulcitol, or inositol.

The authors demonstrate that the larval gut in *aegypti* possesses carbohydrases for sucrose, maltose, trehalose, melezitose, dextrin, starch, and glycogen. The pupae possess an additional carbohydrase (for raffinose). Adults apparently have no enzymes for hydrolyzing either starch or glycogen.

Survival of *aegypti* adults was drastically reduced when they were given ribose, arabinose, rhamnose, sorbose, *a*-methylglucoside, and glycerol; less drastically when given xylose, mannitol, dulcitol, and inositol; all of these sugars being incorporated in 5 percent sucrose.—Jack Colvard Jones, N.I.H., Bethesda, Md.

THE MALARIAL INFECTIVITY OF AN AFRICAN VILLAGE POPULATION TO MOSQUITOES (*Anopheles gambiae*). By Muirhead-Thomson, R. C. Amer. J. trop. Med. Hyg. 6(6):971–979. 1957. 13 refs. The malarial infectivity of an African village community with particular reference to *Plasmodium falciparum* has been tested by selecting subjects at random, irrespective of their blood picture, and feeding batches of laboratory-bred *Anopheles gambiae* on them. The degree of infectiousness has been judged by the number and identity of oöcysts found in the stomach of the engorged mosquitoes after varying periods of incubation. Random tests on 347 subjects of all ages indicate that for every 100 individuals in the African village population of average age composition there are at any one time about 10 or 11 individuals capable of infecting mosquitoes with malaria parasites, mainly *P. falciparum*. All age groups contribute to this infective reservoir, the actual numbers observed being 4.2 infants and toddlers (under 5 years), 3.0 school children (5 to 14 years) and 3.3 adolescents and adults (15 years and over). Most of the infections picked up in this random survey had a low infectivity to mosquitoes. There is no indication that unusually high infectivity is necessarily associated with the lower age groups. It is considered that under these conditions of "hyperendemic" malaria, adolescents and adults form at least 30 percent of the total reservoir of malaria infection in the human population.—Author's summary.

THE TRANSMISSION OF MALARIA IN MALAYA. By Hodgkin, E. P. Stud. Inst. med. Res. Malaya, 27:1–98. 38 refs. 51 tables. 1956. A well-written, authoritative report, this study reflects the experience and industry of the author. In the Foreword, Dr. J. W. Field, Director of the Institute, says in part:

"This Study is a record of ten years' work on the Malayan vectors of malaria. The work done by my former colleague, E. P. Hodgkin, Entomologist of this Institute between 1931 and 1941, makes an impressive record. Based on mosquito dissections made on a scale hitherto without precedent in Malaya—over 90,000 in the course of ten years—it presents a convincing picture of the malaria vectors in Malaya and of their relative importance."

A ten-page introduction reviews topography, climate, population, malaria prevalence, anopheline species, and the history of malaria in Malaya. The terrain varies from mountainous to coastal plain, the water from fresh to brackish. Except in certain well-controlled urban and plan-

tation areas, malaria is general, with *Plasmodium falciparum, P. vivax,* and *P. malariae* present throughout. There are about thirty species of *Anopheles,* all but ten of which are common and suspect as vectors.

"The Investigations" is a chapter of 29 pages, including one section on experimental methods, but devoted primarily to a discussion of each of sixteen areas investigated. The survey of each area included studies on malaria in humans and in the mosquitoes collected, the season for transmission in the area, and the periodicity of the vectors.

"Vector Status of the Malayan *Anopheles,"* is a 12-page chapter opening with a discussion of the prerequisites for an efficient vector of malaria. This is followed by detailed observations on each of the vector and "non-vector" species. *A. maculatus,* both through epidemiological investigations and mosquito gut and gland dissections, appears to be the principal vector in the hill plantations and in the rice-growing valleys. *A. umbrosus, A. letifer,* and *A. barbirostris* are the principal vectors on the coastal plains with fresh water. When *A. sundaicus* attacks man in large numbers it is an efficient vector in the brackish water fringe area. In the same area *A. baezai* exhibits a high infection rate, but is not regarded definitely as a vector because of the absence of epidemiological evidence and of the possibility that the infections were not of human origin. *A. barbirostris* and *A. "hyrcanus"* (*nigerrimus* and *sinensis*) have been associated with outbreaks of malaria in the lowlands. The species which probably do not transmit malaria are: *A. aitkeni, aconitus, karwari, kochi, "leucosphyrus"* (a complex), *philippinensis, roperi, separatus,* and *vagus.*

"The Topography of Transmission," is a 7-page review of transmission in the mountains, the jungle covered hills, the plantation cultivation in the hills, narrow valleys with rice fields, broad valleys with urban areas, the coastal plain with fresh water, and the brackish water fringe.

A one-page summary is followed by a two-page bibliography, and the 51 tables which conclude the report present the results of mosquito collecting, parasite and spleen examinations in man, and gland and gut dissections in mosquitoes.

This is a good-looking book, well bound, with durable, well-printed pages, and conveniently arranged information. I enjoyed reading it.—H. L. Trembley Durkee.

TOP THIS ONE!*

Early in January 1958 personnel of the East Boston Post Office sent out an SOS because mosquitoes were numerous and thirsty in that building. I visited at noon on that cold windy day when outside temperatures ranged from the teens to low twenties. In the warm basement furnace room a couple of Post Office employees were eating lunch—and also providing lunch for at least a score of hungry *Culex pipiens* (?). There were many more mosquitoes in other parts of the basement.

The source of these mosquitoes was a large sump beneath the furnace room floor where storm and wash drain water collected and was intermittently pumped up into the city storm drains at higher elevation. The only apparent cold weather exit for mosquitoes coming from this source was a very small opening around the edge of the manhole cover above the pump.

* From Bob Armstrong, who hopes the publication of this incident will stimulate a flow of anecdotes and incidental bits of interesting information that can be classified under this heading. Perry Ruth reported some incidents of this type, and there must be many more. Send your contribution to the Editor.

REFERENCES TO LITERATURE OF INTEREST TO MOSQUITO WORKERS AND MALARIOLOGISTS

HELEN SOLLERS
Plant Pest Control Division, Agricultural Research Service, United States Department of Agriculture

AEROSOLS

DUCHANOIS, F. R. and ALLTOP, L. B. 1957. The field evaluation of some thermal aerosol formulations for the area control of adult mosquitoes. N. J. Mosquito Extermin. Assoc. Proc. 44:161–169.

JENNE, E. A. 1956. Further investigation of the effect of mosquito fog on various insects. Utah Mosquito Abatement Assoc. Proc. 9:25.

MULHERN, T. D. 1956. Mist blowers custom made for mosquito control. Utah Mosquito Abatement Assoc. Proc. 9:19–20.

AERIAL APPLICATION

JOBBINS, D. M. 1957. Are aircraft applications for the control of New Jersey mosquitoes worthwhile? N. J. Mosquito Extermin. Assoc. Proc. 44:149–151.

STEPHEN, A. 1957. The control of mosquito development in a large swamp area by aerial spraying. Pub. Health (Johannesburg) 20(6): 9–10, 14, 17.

ADULTICIDES AND LARVICIDES

BERTI, A. L., GABALDON, A. and CARRILLO, J. S. 1957. Sobre la necesidad de usar dieldrin en Venezuela. Bol. Ofic. Sanit. Panamer. 43(6): 499–503.

BINSON, G. and DOUCET, J. 1957. Action antipalustre à Abidjan; étude entomologique; lutte antilarvaire. Med. Trop. (Marseille) 17(3):416–421.

BURNETT, G. F. 1957. Trials of residual insecticides against anophelines in African-type huts. Bul. Ent. Res. 48(3):631–668.

DAVIS, A. N. and BEIDER, E. J. 1957. Recent experiments with adulticides against resistant salt-marsh mosquitoes. N. J. Mosquito Extermin. Assoc. Proc. 44:152.

DHIR, S. L. and SINGH, A. 1957. Field studies on the comparative residual effectiveness of DDT and dieldrin against anopheline mosquitoes. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(2):110–116.

HADAWAY, A. B. and BARLOW, F. 1957. The toxicity of three organic phosphorus insecticides to house flies and mosquitoes. World Health Organ. Bul. 16(4):870–873.

HAYASHI, S. and SUZUKI, T. 1957. Analytical observations on the lethal doses of DDT and BHC to mosquito larvae. Studies on the action of insecticides. II. Botyu Kagaku 22(1):138–144. In Jap., Engl. Sum.

LINDQUIST, A. W. 1957. Examples of recent research on mosquitoes by the Entomology Research Branch. Calif. Mosquito Cont. Assoc. Proc. 25: 39–41.

MAILLER, J. P. 1957. The adult mosquito control policies of the Morris County Mosquito Extermination Commission. N. J. Mosquito Extermin. Assoc. Proc. 44:133–134.

MCDUFFIE, W. C., GAHAN, J. B. and DAVIS, A. N. 1957. Recent research on mosquito larvicides by the Entomology Research Division. N. J. Mosquito Extermin. Assoc. Proc. 44:47–50.

RONNEFELDT, F. 1957. Beobachtungen über das verhalten von *Anopheles punct.macula* nach der Anwendung von DDT. Ztschr. f. Tropenmed. u. Parasitol. 8(3):376–391. Engl. Sum.

SHARMA, M. I. D. and BAMI, H. L. 1957. Comparative efficacy of 50 per cent dieldrin-resin powder and 50 per cent dieldrin dispersible powder. Indian Jour. Malariol. 11(2):169–172.

SHARMA, M. I. D. and KRISHNAMURTHY, B. S. 1957. Studies on the susceptibility of *A. subpictus* Grassi, 1899 to chlorinated hydrocarbon insecticides in a Delhi State village. Indian Jour. Malariol. 11(2):231–237.

SOUZA PINTO, G., de. 1956. Sôbre a conveniência e oportunidade da interrupção das medidas anti-anofelinicas, em algumas zonas de malaria. Rev. Brasil. de Malariol. 8(4):616–620.

TURNER, R. G. 1957. New developments in use of insecticides and spray equipment. Calif. Mosquito Cont. Assoc. Proc. 25:65.

VARIOUS TYPES OF CONTROL

ALAMEDA COUNTY (CALIF.) MOSQUITO ABATEMENT DISTRICT. 1956. Twenty-sixth annual report for the calendar year 1956. 13 pp. Oakland.

ARAGÃO, M. B. 1956. Evolução do combate às bromeliáceas que são criadouros de anofelinos. Rev. Brasil. de Malariol. 8(4):643–649.

CONTROL PAPERS FROM CALIF. MOSQUITO CONT. ASSOC. PROC. 25:

BUEHLER, M. H. 1957. Mosquito control activities in the State of Oregon during 1956. pp. 17–18.

GEIB, A. F., MULLA, M. S., EDDY, G. W., PURSING, C. and ISAAK, L. W. 1957. Mosquito control insecticides—where do we go from here? pp. 85–96. [A panel discussion].

LANT, G. 1957. Methods of weed control. p. 66.

MCFARLAND, G. C. 1957. Legal aspects of source reduction. pp. 74–75.

MEYER, C. B. 1957. Water conservation and drainage of irrigated lands under the California water plan. pp. 4–6.

Murray, W. D. 1957. Cooperative. [approach to mosquito source reduction]. pp. 76–77.

Rees, D. M. 1957. Cooperative measures applied in mosquito abatement in Utah during 1956. pp. 14–17.

Robinson, E. C. 1957. Mosquito source reduction. Inter-agency. pp. 77–78.

Simmons, S. W. 1957. Communicable Disease Center Research developments in mosquito control. pp. 42–44.

Vannote, R. L. 1957. The re-evaluation of mosquito control methods in Morris County, New Jersey. pp. 14–15.

CONTROL PAPERS FROM N. J. MOSQUITO EXTERMIN. ASSOC. PROC. 44:

Armstrong, R. L. 1957. Further report on mosquito control in catch basins. pp. 40–43.

Brower, A. K. 1957. Municipal and county cooperation for mosquito control in Ocean County. pp. 128–132.

Douglass, J. W. 1957. The investigation of adult control in municipal governments from 1946–1957 by the Cape May County Mosquito Commission. pp. 135–136.

Kirkland, C. L. 1957. The cooperative plan of drainage and mosquito control practiced in Bergen County. pp. 125–127.

Langford, G. S. 1957. The Maryland mosquito program. pp. 39–40.

Rehn, J. W. H. 1957. Mosquito control activities in the third naval district. pp. 66–68.

Starnes, O. 1957. A research program to meet New Jersey's mosquito control needs. pp. 99–103.

PARASITES AND PREDATORS

James, H. G. 1957. *Mochlonyx velutinus* (Ruthe) (Diptera:Culicidae), an occasional predator of mosquito larvae. Canad. Ent. 89(10): 470–480. [Chaoborinae].

EQUIPMENT

Brockway, P. B., Jr., 1957. Air boat as used by the Toledo Area Sanitary District. N. J. Mosquito Extermin. Assoc. Proc. 44:152–155.

Brumbaugh, L. R., Raley, T. G., Mulhern, T. D. and Greenfield, H. R. 1957. Mosquito equipment control panel. Calif. Mosquito Cont. Assoc. Proc. 25:99–102. [Panel discussion].

Fentem, B. 1957. Coordination of aerial chemical control with ground operations. Calif. Mosquito Assoc. Proc. 25:67.

Fryer, S. H. 1957. The design, development and testing of an insecticide hand duster. World Health Organ. Bull. 16(1):227–238.

Greenfield, H. R. 1957. Construction equipment used in source reduction programs. Calif. Mosquito Cont. Assoc. Proc. 25:102–103.

Mulhern, T. D. 1957. A new "jeep" boom sprayer. Calif. Vector Views 4(11):73.

Paulini, E. and Fonim, A. S. 1956. Estudo relativo a fatôres ligados ao inseticida e à sua aplicação que influem sôbre a eficácia da desinsetização domiciliária: I.—Comparação de vários bicos aspersores empregados pelo S. N. M. e qualificação de sua aspersão. Rev. Brasil de Malariol. 8(2):311–354. Engl. Sum.

Van Wyk, H. 1957. Procurement of surplus equipment for civil defense. Calif. Mosquito Cont. Assoc. Proc. 25:96–97.

REPELLENTS AND ATTRACTANTS

Clyde, D. F. and Kingazi, H. 1957. Diethyl toluamide as a mosquito repellent. East Afr. Med. Jour. 34(5):185–189.

Gilbert, I. H. and Gouck, H. K. 1957. Influence of surface color on mosquito landing rates. Jour. Econ. Ent. 50(5):678–680.

INSECT RESISTANCE

Chadwick, L. E. 1957. Progress in physiological studies of insecticide resistance. World Health Organ. Bul. 16(6):1203–1218.

Ciuca, M. and Others. 1957. Susceptibility and "natural tolerance" to insecticides on the part of local vectors after eight years of application of the imagocide method in Romania. Comparative study of the various tests of efficacy and residual power of DDT and BHC with the Busvine and Nash standard test. II. Preliminary observations relating to sensitivity to DDT and BHC on the part of *Anopheles* of the *maculipennis* group in North Moldavia. World Health Organ./ Mal/190, 13 pp.

Darsie, R. F., Jr., Krause, J. B. and Beadle, L. D. 1957. Status of insecticide-resistance in Delaware's salt-marsh mosquitoes. N. J. Mosquito Extermin. Assoc. Proc. 44:169–176.

Davidson, G. 1957. Studies on insecticide resistance in anopheline mosquitoes. World Health Organ./Mal/192 and Insecticides/69, 58 pp.

Milani, R. 1957. Genetic research on the resistance of insects to the action of toxic substances. World Health Organ. Inform. Cir. on the Resistance Prob. Supp. C., Oct., 64 pp.

Quarterman, K. D. 1957. Comments on the appendix to the report of the technical conference on insect resistance Geneva, 25–31 July 1957. World Health Organ./Insecticides/70, 2 pp.

Raffaele, G. and Coluzzi, M. 1957. Ricerche sul problema della resistenza degli anofeli agli insetticidi. Nota I. Alcune osservazioni sulle mondalitá di attuazione del metodo di "Busvine" e "Nash." Nota II. Su alcune variazioni della sensibilità degli anofeli al D.D.T. Nota III. Indagine sulla sensibilità al DDT degli anofeli di varie regioni d'Italia dopo 10 anni di trattamento con insetticidi. Riv. di Malariol. 36(4/6):157–166; 167–176; 177–202.

Sharma, M. I. D. and Krishnamurthy, B. S. 1957. Development of resistance to DDT in *A. subpictus* Grassi, 1899, in a Delhi State Village. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(1):78.

——. 1957. Effectiveness of diazinon-residual spray on DDT resistant *A. subpictus* in a village in Delhi State. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(3): 200–201.

WORLD HEALTH ORGANIZATION. 1957. Technical conference on insect resistance to consider an international collaborative programme of research. World Health Organ./Insecticides/66, 37 pp.

WRIGHT, R. H. 1957. A theory of olfaction and of the action of mosquito repellents. Canad. Ent. 89(11):518–528.

TOXICOLOGY

BLAZQUEZ, J. and BIANCHINI, C. 1957. Estudio de los primeros casos de intoxicacion por dieldrin y aplicacion de la xenodeterminacion en humanos. Bol. Ofic. Sanit. Panamer. 43(6):504–511.

HAYES, W. J., JR. 1957. Dieldrin poisoning in man. U. S. Pub. Health Rpts. 72(12):1087–1091. Spanish version published as: Un estudio sobre la intoxicacion producida en el hombre por el dieldrin. Bol. Sanit. Panamer. 43(6):534–539.

IBANEZ PETERSON, E. H. and FRANZETTI, R. P. de. 1957. Estudios psicometricos y su valor clinico en rociadores de dieldrin. Bol. Ofic. Sanit. Panamer. 43(6):531–533.

JOLLY, D. W. 1957. The toxicity of organic phosphorus insecticides. Vet. Rec. 69(34):796–800.

MATHURIN, L. 1957. Deux cas d'intoxication mortelle de petits enfants par malocide and optalidon. Med. Trop. (Marseilles) 17(1):122–124.

MÜLLER, A., VELASQUEZ, A., SCHMIDT, E. and MCQUARY, W. A. 1957. Metodo para captar y analizar muestras ambientales de dieldrin. Bol. Ofic. Sanit. Panamer. 43(6):518–526.

REYNOLDS, J. G. 1957. The determination of dieldrin in blood. Bol. Ofic. Sanit. Panamer. 43 (6):527–530.

WEBBE, G. 1957. The action on fish of several chlorinated hydrocarbons when used as larvicides. Ann. Trop. Med. and Parasitol. 51(3):264–270.

WINTHROP, G. J., and FELICE, J. R. 1957. Un estudio clinico-toxicologico en rociadores de un insecticida de hidrocarburo clorado. Bol. Ofic. Sanit. Panamer. 43(6):512–517.

INSECTICIDES AND CHEMICALS

BAMI, H. L. 1955. Testing of 75 percent DDT water dispersible powder and possible causes and cure for the defective materials. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 3(5):161–164.

——— and CHEEMA, L. S. 1957. Studies on particle size distribution in relation to suspensibility. Part I. 50 percent DDT water dispersible powders. Indian Jour. Malariol. 11(2):173–182.

BAMI, H. L., CHEEMA, L. S. and DHATT, M. S. 1957. D.D.T. water dispersible powders: Studies on suspensibility in relation to accelerated tropical storage treatment. Indian Jour. Malariol. 11(2): 139–145.

DURHAM, W. F. 1957. The toxicity of chemicals used in mosquito control. N. J. Mosquito Extermin. Assoc. Proc. 44:155–160.

LOZANO MORALES, A. 1957. Nuevas consideraciones en torno a la reserva oficial de un superinsecticida. Rev. de Sanid. e Hig. Pub. (Madrid) 31(3/5):97–100.

MALARIA SECTION OF WHO. 1957. Assessment of susceptibility to insecticides in anopheline mosquitoes. World Health Organ. Bul. 16(4):874–890.

METCALF, R. L. Editor. 1957. Advances in pest control research. Vol. I. 514 pp., New York.

PAULINI, E. 1957. Adsorção do DDT pelo barro. Bol. Ofic. Sanit. Panamer. 43(5):433–438.

SHEPARD, H. H. 1957. The pesticide situation for 1955–1957. Commodity Stabilization Serv., U. S. Dept. Agr. 19 pp. Wash. D. C.

VARGAS, L. 1957. Principios de formulacion de insecticidas. Bol. Epidemiologico 21(1):10–30.

BIOLOGY AND ECOLOGY

ARAGÃO, M. B. 1956. Aspectos climáticos do problema bromélia-malaria. I. Distribuição geográfica dos anofelinos do sub-genêro *Kerteszia* no Brasil. Rev. Brasil. de Malariol. 8(4):621–631.

BAR-ZEEV, M. 1957. The effect of extreme temperatures on different stages of *Aedes aegypti*. Bul. Ent. Res. 48(3):593–599.

CHANG, T. H. 1956. A preliminary report on the hibernation of mosquitoes in Changsha, Hunan Province. Acta Ent. Sinica 6(3):343–351. In Chin., Engl. Sum.

DIXON, E. B. 1957. Analysis of water containing *Aedes sollicitans* in Kentucky. Jour. Tenn. Acad. Sci. 32(2):147–151.

HECHT, O. and CORZO, J. H. 1957. Beitrag zur biologie einiger mexikanischer anophelen. Ztschr. u. Parasitol. 8(3):391–404. Engl. Sum.

MA, S. F. and FENG, L. C. 1956. The mosquito species and their breeding habits as observed in representative parts of Hopei Province. Acta Ent. Sinica 6(2):169–191. In Chin., Engl. Sum.

NEOGY, B. P., KACHROO, P. and BIWAS, K. 1957. Aquatic vegetation of Bokaro reservoir in relation to anopheline mosquito larvae and its control by application of herbicides. Indian Jour. Malariol. 11(2):191–212.

PLATT, R. B., COLLINS, C. L. and WITHERSPOON, J. P. 1957. Reactions of *Anopheles quadrimaculatus* Say to moisture, temperature, and light. Ecol. Monogr. 27(3):303–324.

PRADHAN, S., MUNDKUR, S. S. 1957. The effect of temperature on the susceptibility of mosquito (*Culex fatigans*) larvae to DDT suspensions. Ztschr. f. Angew. Ent. 40(3):371–379.

REMM, K. I. 1957. Zur faunistik und oekologie der culiciden (Diptera, Culicidae) der Estnischen SSR. Ent. Obozr. 36(1):148–160. Germ. Sum.

TELFORD, A. D. 1957. The pasture *Aedes* of central and northern California. The egg stage:

gross embryology and resistance to desiccation. Ent. Soc. Amer. Ann. 50(6):537–543.

GENETICS

D'Alessandro, G., Frizzi, G. and Mariani, M. 1957. Effect of DDT selection pressure on the frequency of chromosomal structures in *Anopheles atroparvus*. World Health Organ. Bul. 16(4): 859–864.

Milani, R. 1957. Errori genetici sulla ereditarietà della resistenza agli insetticidi. Riv. di Parassitol. 18(2):129–132.

Wolcott, G. B. 1957. Chromosome studies in the genus *Plasmodium*. Jour. Protozool. 4(1): 48–51.

BEHAVIOR

Galindo, P. 1957. A note on the oviposition behavior of *Sabethes* (*Sabethoides*) *chloropterus* Humboldt. Ent. Soc. Wash. Proc. 59(6):287–288.

Gillies, M. T. 1957. Age-groups and the biting cycle in *Anopheles gambiae*. A preliminary investigation. Bul. Ent. Res. 48(3):553–559.

Hagmann, L. E. 1957. Observations on the dispersion of *Culex pipiens* adults from a large breeding area. N. J. Mosquito Extermin. Assoc. Proc. 44:106–108.

Mouchet, J. 1957. Observations sur quelques *Anopheles* exophiles au Cameroun. Soc. de Path. Exot. Bul. 50(3):378–381.

—— and Gariou, J. 1957. Exophilie et exophagie d'*Anopheles gambiae* Giles 1902, dans le sud Cameroun. Soc. de Path. Exot. Bul. 50 (3):446–461.

Pletsch, D. J., Tseng, P. T. and Chen, H. H. 1956. Daytime populations of anophelines in houses and stables of rural Taiwan (Formosa), China. Formosan Med. Assoc. Jour. 55(12):614–621.

MORPHOLOGY AND PHYSIOLOGY

Bassler, U. 1957. Zur funktion des Johnstonorganes bei der orientierung der stechmücken. Naturwissenchaften 44(11):336–337. [*Aedes aegypti*]

Bhatia, M. L. and Wattal, B. L. 1957. Description of a hitherto unknown structure in the mouth parts of mosquitoes. Indian Jour. Malariol. 11(2):183–189.

Gillett, J. D. 1957. Variation in the time of release of the ovarian development hormone in *Aedes aegypti*. Nature (London) 180(4587):656–657.

Gonda, O., Traub, A. and Avi-Dor, Y. 1957. Studies on the respiration of washed particles derived from the mosquito *Aedes aegypti* L. I. The citric acid cycle and oxidative phosphorylation. Israel Res. Council Bul. 6A(3/4):321.

Harwood, R. F. and Horsfall, W. R. 1957. Development, structure, and function of covering of eggs of floodwater mosquitoes. I. Ovarian development. Ent. Soc. Amer. Ann. 50(6):555–561.

Hsieh, L. K. and Liao, T. S. 1956. Morphological variations of some mosquitoes in Amoy. Acta Ent. Sinica 6(3):375–376. In Chin. [*Culex* spp.]

Matsubara, H. 1957. On the color change of the triturated solution of larvae of the common house mosquito, *Culex pipiens* var. *pallens* Coq. Botyu-Kagaku 22(1):19–23. In Jap., Engl. Sum.

Nakata, G. 1957. The effect of sodium chloride present in the medium on the oviposition and viability of *Aedes aegypti* Linn. Botyu-Kagaku 22(1):74–80. In Jap., Engl. Sum.

Raffaele, G., Coluzzi, A. and Zulueta, J., de. 1957. Observations on the effect of numbers and age on the susceptibility of mosquitoes to DDT. World Health Organ./Mal/194, 7 pp.

Roubaud, E. and Gheleovitch, S. 1957. Sur la differenciation des éléments du complexe par la morphologie du phallosome, chez le moustique commun paléarctique *Culex pipiens*. Acad. des Sci. Compt. Rend. 245(1):7–9.

Whitehead, F. E. 1957. Flight range of rice field mosquitoes. Ark. Agr. Expt. Sta. Bul. 590, 7 pp.

TECHNIQUES

Burcham, E. 1957. Artificial insemination of *Aedes aegypti* (L.). Canad. Ent. 89(11):494–495.

Gerolt, P. 1957. Improved persistence of dieldrin deposits on sorptive mud surface. Nature (London) 180(4582):394–395.

Goodwin-Bailey, K. F., Holborn, J. M. and Davies, M. 1957. A technique for the biological evaluation of insecticidal aerosols. Ann. Applied Biol. 45(2):347–360.

Jeffery, G. M. 1957. Extended low-temperature preservation of human malaria parasites. Jour. Parasitol. 43(4):488.

Lopp, O. V. 1957. Egg sampling as an index of mosquito breeding. N. J. Mosquito Extermin. Assoc. Proc. 44:60–64.

Roberts, H. R. and Kolor, M. G. 1957. A rapid procedure for the separation of amino-acids on paper chromatograms. Nature (London) 180 (4582):384–385.

Swaroop, S. 1957. Index of endemicity. World Health Organ. Bul. 16(6):1083–1101.

———. 1957. Statistical methodology in malaria work. World Health Organ./Mal/174 Rev. 1,/HS/58 Rev. 1. 246 pp.

TAXONOMY

Chen, H. H. 1956. Keys to the 19 species of mosquitoes common in Taiwan (Formosa), China. Formosan Med. Assoc. Jour. 55(10):487–493.

Darsie, R. F., Jr., 1957. Notes on American mosquito pupae II. The *Aedes* (*Ochlerotatus*) *punctor* subgroup, with key to known Nearctic *Aedes* pupae (Diptera, Culicidae). Ent. Soc. Amer. Ann. 50(5):611–620.

Dobrotworsky, N. V. 1956. Notes on Australian mosquitoes (Diptera, Culicidae). I. Linn. Soc. N. S. Wales Proc. 81(381):105–114.

Gaud, J. 1957. Soies doublées chez divers arthropodes parasites. Ann. de Parasitol. Humaine et Compar. 32(3):298–302.

HALCROW, J. G. 1957. A new sub-species of *Anopheles gambiae* from Mauritius. East Afr. Med. Jour. 34(4):133–135.

LAIRD, M. 1957. A new mosquito from Fiji, *Aedes* (*Finlaya*) *freycinetiae* n. sp. (Diptera: Culicidae). Pacific Sci. 11(3):342–351.

LEWALLEN, L. L. 1957. Paper chromatography studies of the *Anopheles maculipennis* complex in California (Diptera:Culicidae). Ent. Soc. Amer. Ann. 50(6):602–606.

LIU, C. W. and FENG, L. C. 1956. On a species of *Theobaldia, Theobaldia kanayamensis* newly discovered from Peking. Acta Ent. Sinica 6(3):335–341. In Chin., Engl. Sum.

RAGEAU, J. and HAMON, J. 1957. *Aedes* (Diptera:Culicidae) appartenant au sous-genre *Mucidus* en Nouvelle-Caledonie. Soc. de Path. Exot. Bul. 50(3):372–378.

RIVOLA, E. and HOLSTEIN, H. M. 1957. Note sur une variété d'*Anopheles nili* Theo. Soc. de Path. Exot. Bul. 50(3):382–387.

SENEVET, G., ANDARELLI, L. and GRAELLS, R. 1957. Les epines préclypéales des larves de moustiques; leur utilisation dans la diagnose. Inst. Pasteur d'Algerie Arch. 35(2):83–89.

———. 1957. Les soies dorsales prothoraciques chez les larves de *Culex*. Inst. Pasteur d'Algerie Arch. 35(2):90–98.

VARGAS, L. 1956. Algunas diferencias morfológicas entre *Toxorhynchites rutilus* y *T. septentrionalis*. Inst. de Salubridad y Enferm. Trop. Rev. (Mexico) 16(4):33–36. Engl. Sum.

VINCKE, I. H., HOLSTEIN, M. H. and RIVOLA, E. 1957. Note sur *Anopheles demeilloni* Evans et *Anopheles marshalli* var. *pitchfordi* Giles au Congo Belge. Soc. de Path. Exot. Bul. 50(3): 391–397.

DISTRIBUTION

BURGESS, L. 1957. Note on *Aedes melanimon* Dyar, a mosquito new to Canada (Diptera:Culicidae). Canad. Ent. 89(11):532.

GRJEBINE, A. 1957. Données récentes sur les culicidés d'Afrique Equatoriale Française. I. Culicinés. Ann. de Parasitol. Humaine et Compar. 32(3):331–341.

LUKASIAK, J. 1957. Wystepowanie *Anopheles bifurcatus* Meigen, 1818, (*Anopheles claviger*, Meig., 1804) na obszarze Warszawy. Przeglad Epidemiol. (Warsaw) 11(2):123–130. Engl. Sum. [See Lukasiak for similar title under Distribution —Mosquito News 17(3):228, 1957].

DENGUE

HOTTA, S. 1957. Some immunological properties of dengue virus cultivated in tissue culture. Ann. Trop. Med. and Parasitol. 51(3):249–255.

SMITH, C. E. G. 1957. A localized outbreak of dengue fever in Kuala Lumpur: serological aspects. Jour. Hyg. (London) 55(2):207–223.

ENCEPHALITIS

BURBUTIS, P. P. and JOBBINS, D. M. 1957. *Culiseta melanura* Coq. and eastern equine encephalomyelitis in New Jersey. N. J. Mosquito Extermin. Assoc. Proc. 44:68–78.

COHEN, D. and SUSSMAN, O. 1957. Equine encephalomyelitis in New Jersey. N. J. Mosquito Extermin. Assoc. Proc. 44:79–91.

FRENCH, E. L., ANDERSON, S. G., PRICE, A. V. G. and RHODES, F. A. 1957. I. Isolation of Murray Valley encephalitis virus from the brain of a fatal case of encephalitis occurring in a Papuan native. Amer. Jour. Trop. Med. and Hyg. 6(5): 827–834.

HANSON, R. P. 1957. An epizootic of equine encephalomyelitis that occurred in Massachusetts in 1831. Amer. Jour. Trop. Med. and Hyg. 6(5): 858–862.

FILARIASIS

CHOW, C. Y. and THEVASAGAYAM, E. S. 1957. Bionomics and control of *Culex pipiens fatigans* Wied. in Ceylon. World Health Organ. Bul. 16 (3):609–632.

EDESON, J. F., HAWKING, F. and SYMES, C. B. 1957. The periodicity of microfilariae. VI. The response of microfilariae of *Wuchereria malayi* and *W. bancrofti*, Pacific type, to various stimuli. Roy. Soc. Trop. Med. and Hyg. Trans. 51(4): 359–365.

EDESON, J. F. and WHARTON, R. H. 1957. The transmission of *Wuchereria malayi* from man to the domestic cat. Roy. Soc. Trop. Med. and Hyg. Trans. 51(4):366–370.

GALLIARD, H. 1957. Outbreak of filariasis (*Wuchereria malayi*) among French and North African servicemen in North Vietnam. World Health Organ. Bul. 16(3):601–608.

———. 1957. Prophylaxie de la filariose a *Wuchereria bancrofti* a Tahiti. Ann. Parasitol. Humaine et Compar. 32(3):348–351.

GUNEWARDENE, K. 1956. Observations on the development of *Dirofilaria repens* in *Aedes* (*Stegomyia*) *albopictus* and other common mosquitoes of Ceylon. Ceylon Jour. Med. Sci. 9(1):45–53.

HAWKING, F. 1957. The distribution of bancroftian filariasis in Africa. World Health Organ. Bul. 16(3):581–592.

HENNIGAR, G. R. and FERGUSON, R. W. 1957. Pulmonary vascular sclerosis as a result of *Dirofilaria immitis* in dogs. Amer. Vet. Med. Assoc. Jour. 131(7):336–340.

KARTMAN, L. 1957. The vector of canine filariasis; a review with special reference to factors influencing susceptibility. Rev. Brasil. de Malariol. Pub. Avulsas No. 5, 41 pp. Rio de Janeiro.

KESSEL, J. F. 1957. An effective programme for the control of filariasis in Tahiti. World Health Organ. Bul. 16(3):633–664.

KIRK, R. 1957. Filariasis in the Sudan. World Health Organ. Bul. 16(3):593–599.

KUME, S. and OHISHI, I. 1957. Observations on the chemotherapy of canine heartworm infection with arsenicals. Amer. Vet. Med. Assoc. Jour. 131(10):476–480.

MATTINGLY, P. F. 1957. Notes on the taxonomy and bionomics of certain filariasis vectors. World Health Organ. Bul. 16(3):686-696.

Rachou, R. G. and Lacerda, N. B. 1956. Da transmissão da filariose bancroftiana em Manaus (Amazonas). Rev. Brasil. de Malariol. 8(2): 369–371.

Raghavan, N. G. S. 1957. Epidemiology of filariasis in India. World Health Organ. Bul. 16(3):553–579.

Rahman, J., Singh, M. V. and Gujral, J. S. 1957. Investigation of filariasis problem in Ballia Town (Uttar Pradesh). Indian Jour. Malariol. 11(2):163–167.

Rook, H., de. 1957. Filariasis on the Island of Pam. Doc. Med. Geog. et Trop. 9(3):197–212.

Turner, L. H. and Edeson, J. F. B. 1957. Studies on filariasis in Malaya: the periodicity of the microfilariae of *Wuchereria malayi*. Ann. Trop. Med. and Parasitol. 51(3):271–277.

Wharton, R. H. 1957. Studies on filariasis in Malaya: Observations on the development of *Wuchereria malayi* in *Mansonia* (*Mansonioides*) *longipalpis*. Notes on the breeding of *Mansonia* (*Mansonioides*) mosquitoes in the laboratory. Ann. Trop. Med. and Parasitol. 51(3):278–296; 297–300.

Zulueta, J., de. 1957. Observations on filariasis in Sarawak and Brunei. World Health Organ. Bul. 16(3):699–705.

MALARIA

Colonial Office. 1956. Colonial research 1955–1956. Colonial Medical Research Comm. Eleventh annual report (1955–1956). (Himsworth, H. P., Chairman). pp. 135–180, London.

Expert Committee on Malaria. Sixth report. World Health Organ. Tech. Rpt. Ser. 123, 84 pp.

Eysseric, G., Benazet, F. and Sohier, R. 1957. Les séro-réactions de Henry chez les Européens rapatriés de zone d'endémie palustre. Soc. de Path. Exot. Bul. 50(3):462–473.

Floch, H. 1956. Influence du paludisme sur la natalite, la mortinatalite et la mortalite infantile. Rev. Brasil. de Malariol. 8(4):541–544.

Fontaine, R. E., Hollister, A. C., Jr. and Beck, M. D. 1957. Recent indigenous malaria in Sutter County. Calif. Vector Views 4(11):72.

Kraan, H. 1957. Import of malaria in the Netherlands. Doc. Med. Geog. et Trop. 9(3): 269–272.

Macdonald, G. 1957. The epidemiology and control of malaria. 270 pp., London.

Milovanović, M. and Popović, D. 1957. Malaria in Siberia from 1952 to 1956. Bul. Inst. Hyg. (Belgrade) 6(1/2):105–120. In Serb., Engl. Sum.

Milutina, E. Y., Simkovich, E. I. and Dimand, S. V. 1957. Results of the malaria and helminthiasis control in the Moldavian SSR. Med. Parazit. i Parazit. Bolezni 26(5):588–592. In Rus.

Muirhead-Thomson, R. C. 1957. The malarial infectivity of an African village population to mosquitoes (*Anopheles gambiae*). A random xenodiagnostic survey. Amer. Jour. Trop. Med. and Hyg. 6(6):971–979.

Peters, W. and Standfast, H. 1957. Report on a malaria survey in the Sepik district. Med. Jour. Austral. 44(25):861–868.

Pokrovsky, S. N. and Leizerman, L. I. 1957. Malaria control in the RSFSR following the second World War (1946–1956). Med. Parazit. i Parazit. Bolezni 26(5):575–578. In Rus.

Rubinstein, B. B. 1957. On the incidence of malaria in the Biclorussian SSR. Med. Parazit. i Parazit. Bolezni 26(5):592–594. In Rus.

Sautet, J. 1957. Nouvelles diffcultés dans la lutte antipaludique et antiamarile par les pulvérisations murales d'insecticides rémanents. Presse Med. (Paris) 65(50):1170–1171.

Sergiev, P. G. and Rashina, M. G. 1957. The results of malaria control in the USSR and future problems. Med. Parazit. i Parazit. Bolezni 26(5): 520–531. In Rus.

Shipitsina, N. K. 1957. Phenological service for 20 years (1936–1956) and its significance for the malaria control in the USSR. Med. Parazit i Parazit. Bolezni 26(5):532–540. In Rus.

Sliwensky, M. 1957. Ein querschmitt durch die tropenkrankheiten Bulgariens. Ztschr. f. Tropenmed. u. Parasit. 8(1/2): 246–269. [Includes DDT control in malaria campaign].

Spencer, T. E. T., Spencer, M., Jemesen, M. T. and Tommerup, J. W. J. 1956. Malaria in the Mount Hagen area. Papua and New Guinea Med. Jour. 1(4):110–113.

Wartena, B. 1957. Malaria in Friesland. Doc. Med. Geog. et Trop. 9(3):252–254.

Malaria—Clinical Aspects

Crossley, H. 1957. Malaria in a Saskatchewan-born infant. Canad. Med. Assoc. Jour. 77(3): 225–226.

Soberon y Parra, G. 1956. Hechos sobresalientes en la clínica y en el tratamiento del paludismo. Gac. Med. de Mexico 86(6):387–400.

Malaria—Eradication Projects

Agaev, B. M. 1957. On the course of eradication of malaria in the Azerbaijan SSR and on the control of helminthiasis and other parasitic diseases. Med. Parazit. i Parazit. Bolezni 26(5): 594–598. In Rus.

Bokhnan, K. A. and Shamardin, M. V. 1957. Eradication of malaria and helminthiasis control in the Estonian SSR. Med. Parazit. i Parazit. Bolezni 26(5):598–599. In Rus.

Boletin Oficina Sanitaria Panamericana. 1957. I. Reunion de directores de los servicos nacionales de erradicacion de la malaria, de Argentina, Bolivia, Brasil y Paraguay. V. Reunion de directores de los servicos nacionales de erradicacion de la malaria, de Centro America, Mexico y Panama. Bol. Ofic. Sanit. Panamer. 43(4):382–385; 386–388.

Ciuca, M. 1957. The eradication of malaria, the present stage of antipaludian action in the R. P. R. within the vast complex of this problem extended to a worldwide level. Rumanian Med. Rev. 1(1):27–37. Also in Microbiol., Parazitol. si Epidemiol. No. 2, 1956.

Kviklis, V. N. and Taunene, A. I. 1957. Eradication of malaria and helminthiasis control

in the Lithuanian SSR. Med. Parazit i Parazit. Bolezni 26(5):600–601.

RUSSELL, R. F. 1957. Surveillance in malaria eradication projects. World Health Organ./Mal/Inform/28, 7 pp.

WEEKS, E. B. 1957. Malaria eradication as a world program. Amer. Med. Women's Assoc. Jour. 12(7):202–204.

Malaria—Plasmodia

BAKER, J. R. 1957. A new vector of *Haemoproteus columbae* in England. Jour. Protozoology 4(3):204–208. [*Plasmodium*].

BALL, G. H. and CHAO, J. 1957. Development in vitro of isolated oocysts of *Plasmodium relictum*. Jour. Parasitol. 43(4):409–412.

BRAY, R. S. 1957. *Plasmodium ovale* in Liberia. Amer. Jour. Trop. Med. and Hyg. 6(6): 961–970.

CORRADETTI, A. and NERI, I. 1957. *Plasmodium subpraecox* Grassi e Feletti 1892 ceppo di *Plasmodium praecox* Grassi e Feletti 1890 adattato a vivere nella civetta *Carcine noctua*. Rend. Istit. Super. di Sanita 20(3):230–234.

GREENBERG, J. and KENDRICK, L. P. 1957. Parasitemia and survival in inbred strains of mice infected with *Plasmodium berghei*. Jour. Parasitol. 43(4):413–419.

———. 1957. Some characteristics of *Plasmodium berghei* passed within inbred strains of mice. Jour. Parasitol. 43(4):420–427.

JORDAN, H. B. 1957. Host resistance and regulation of the development of *Plasmodium lophurae* in pheasants, coots and domestic pigeons. Jour. Parasitol. 43(4):395–408.

MUIRHEAD-THOMSON, R. C. 1957. Notes on the characters of *P. malariae* oocysts of possible value in mixed infections. Amer. Jour. Trop. Med. and Hyg. 6(6):980–986.

PRAKASH, S. 1957. Studies on *Plasmodium berghei* Vincke and Lips, 1948. XXV. The role of casein diet on the acquired immunity of mice infected with *P. berghei*. Indian Jour. Malariol. 11(2):221–229.

RAMAKRISHNAN, S. P., PRAKASH, S. and CHOUDHURY, D. S. 1957. Studies on *Plasmodium berghei* Vincke and Lips, 1948. XXIV. Selection of a chloroquine resistant strain. Indian Jour. Malariol. 11(2):213–220.

RAY, A. P. 1957. Studies on Nuri strain of *P. knowlesi*. Part XIV. Pathological processes in the liver. Indian Jour. Malariol. 11(2):239–246.

SERGIEV, P. G. and DEMINA, N. A. 1957. Studies of immunity to *Plasmodium berghei* infection. I. The transmission of acquired immunity against *P. berghei* from female rats to their offspring. Indian Jour. Malariol. 11(2):129–138.

Malaria-Therapeutics and Antimalarials

ANONYMOUS. 1957. Estadística de los dispensarios antipalúdicos dependientes de la Director General de Sanidad. Rev. de Sanid. e Hig. Pub. (Madrid) 31(3/5):209–233.

DA COSTA MOURÃO, M. 1956. Profilaxia do paludismo com paludrina e daraprim nas escolas de daraprim nas escolas de S. Tomé. Inst. de Med. Trop. An. (Portugal) 13(3):451–464. Engl. Sum.

DAVIS, M. J. and VANDER PLOEG, D. E. 1957. Acute porphyria and coproporphyrinuria following chloroquine therapy. A report of two cases. Arch. Dermatol. 75(6):796–800.

DUFFIN, W. M. and ROLLO, I. M. 1957. Antimalarial activity of hydroxy-substituted naphthalene compounds. Brit. Jour. Pharmacol. and Chemother. 12(2):171–175.

HOEKENGA, M. T. 1957. Propoquin in treatment of malaria. Amer. Jour. Trop. Med. and Hyg. 6(6):987–989.

MISRA, B. G. and NAIR, C. P. 1957. Stability of proguanil resistance in *P. knowlesi*. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(3):202–204.

PEREIRA, J. P. and PAULINI, E. 1956. Método turbidimétrico para dosaqem de microquantidades de chloroquina. Rev. Brasil. de Malariol. 8(4): 613–615.

PINOTTI, M. and SOARES, P. 1956. A erradicação da malária com o sal chloroquinado. Rev. Brasil. de Malariol. 8(1):253–265. Engl. Sum.

RAFFAELE, G. and CARRESCIA, P. 1957. Effect of single doses of a combination of chloroquine and pyrimethamine. World Health Organ./Mal/193, 5 pp.

RAYMOND-HAMET, —. 1956. La cinchonamine et l'aricine ont-elles une influence sur l'infection de la souris par le *Plasmodium berghei* Vincke et Lips? Compt. Rend. Soc. de Biol. Paris 150 (11):1883–1885.

YOUNG, M. D. and BURGESS, R. W. 1957. Effect of 25 milligrams of pyrimethamine on the infectivity of *Plasmodium vivax*, St. Elizabeth strain, to *Anopheles quadrimaculatus*. Amer. Jour. Trop. Med. and Hyg. 6(5):805–807.

WILSON, T., and EDESON, J. F. B. 1957. Studies on the chemotherapy of malaria. VI. The role of suppressive drugs in malaria control in Malaya. Med. Jour. Malaya 11(3):190–200.

Malaria—Vectors

BHATIA, M. L. and KRISHNAN, K. S. 1957. Malaria vectors of India. IX. *A. culicifacies*, Giles, 1901. Natl. Soc. India for Malaria and other Mosquito-Borne Dis., Bul. 5(1):1–34.

BHATIA, M. L., PRAKASH, S. and RAMAKRISHNAN, S. P. 1957. Malaria vectors and some epidemiological features of rajasthan. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(2):100–109.

YELLOW FEVER

BONNEL, P. H. 1957. Reglamentacion internacional de la vacunacion contra la fiebre amarilla. Bol. Ofic. Sanit. Panamer. 43(4):356–368.

BOSHELL, J. and GROOT, H. 1957. Encuesta inmunologica sobre fiebre amarilla en primates silvestres de America Central (1952–1957). Bol. Ofic. Sanit. Panamer. 43(4):309–322. Engl. Sum.

Breland, O. P. 1957. Some factors that might influence the reintroduction of yellow fever into the United States. Tex. Jour. Sci. 9(3):262–266.

Cannon, D. A., Dewhurst, F. and Meers, P. D. 1957. Mass vaccination against yellow fever by scarification with 17D strain vaccine. Ann. Trop. Med. and Parasitol. 51(3):256–263.

Courtois, G. 1957. Aparicion y duracion de la inmunidad conferida por la vacuna 17D. Bol. Ofic. Sanit. Panamer. 43(4):335–340.

Gahona Molina, J. F. 1957. La fiebre amarilla en el estado de Colina. Bol. Epidemiologico 21(1): 1–4.

Khurana, B. S., Bhatia, M. L. and Sharma, M. I. D. 1957. Note on the *Stegomyia* survey of air and sea ports of Bombay. Natl. Soc. India for Malaria and other Mosquito-Borne Dis. Bul. 5(2): 89–99.

Meers, P. D. 1957. Yellow fever vaccination by scarification with the 17D strain: an appreciation of the present position. Roy. Soc. Trop. Med. and Hyg. Trans. 51(4):338–345.

Rodaniche, E., de 1957. Survey of primates captured in Panama, R. P. during the years 1952–1956 for protective antibodies against yellow fever. Amer. Jour. Trop. Med. and Hyg. 6(5): 835–839.

Smithburn, K. 1957. Inmunologia de la fiebre amarilla. Bol. Ofic. Sanit. Panamer. 43(4):323–334.

Souza Manso, C., de 1957. Vacinação em massa contra a febre amarela no Brasil. Bol. Ofic. Sanit. Panamer. 43(4):341–355.

OTHER DISEASES

Gluschenko, P. A., Gutsevich, A. V. and Dukina, M. S. 1957. Mosquitoes as vectors of the virus of lymphocytary choriomeningitis in the western part of the Ukraine. Akad. Nauk. SSSR. Dok. 113(5):1181–1183. In Rus.

Lennette, E. H., Ota, M. I. and Hoffman, M. N. 1957. Turlock virus: a description of some of its properties. Amer. Jour. Trop. Med. and Hyg. 6(6):1036–1046.

Lennette, E. H. and Others. 1957. Turlock virus: A presumably new arthropod-borne virus. Isolation and identification. Amer. Jour. Trop. Med. and Hyg. 6(6):1024–1035.

Mason, P. J. and Haddow, A. J. 1957. An epidemic of virus disease in Southern Province, Tanganyika Territory, in 1952–53. An additional note on chikungunya virus isolations and serum antibodies. Roy. Soc. Trop. Med. and Hyg. Trans. 51(3):238–240.

Work, T. H. and Others. 1957. Kyasanur forest disease. III. A preliminary report on the nature of infection and clinical manifestations in human beings. Indian Jour. Med. Sci. 11(8): 619–645. [Possibility of being transmitted by mosquitoes].

LITERATURE REFERENCES AND REVIEWS

Dukhanina, N. N. 1957. The USSR literature on problems of medical parasitology and parasitic diseases for the first six months of 1957. Med. Parazit. i Parazit. Bolezni 26(5):624–639. [Section 3 has references to malaria].

Sollers, H. 1957. References to literature of interest to mosquito workers and malariologists. Mosquito News 17(4):328–336.

World Health Organization. 1957. Select bibliography on the toxicity of pesticides to man and animals 1953–1955. World Health Organ. Bul. 16(6):1219–1241.

BIOGRAPHY AND HISTORY

Dillistin, W. H. 1957. The creation of the State Mosquito Control Commission. N. J. Mosquito Extermin. Assoc. Proc. 44:6–11.

Juhn, B. 1957. Ronald Ross; bezwinger der malaria. Wien. Med. Wschr. 107(27):558–559.

Pepper, B. B. and Schmitt, J. B. 1957. Leland O. Howard—the pioneer in mosquito control. N. J. Mosquito Exterm. Assoc. Proc. 44:43–46.

Singh, Jaswant. 1957. First birth centenary of Sir Ronald Ross. Indian Jour. Malariol. 11(2): 127–128.

PUBLIC RELATIONS

Brown, H. B. 1957. Public relations. Calif. Mosquito Cont. Assoc. Proc. 25:66–67.

Dietz, H. A. 1957. Water law affecting mosquito abatement. Calif. Mosquito Cont. Assoc. Proc. 25:7–12.

Dooley, T. 1957. The interest of the State Legislature in mosquito control. Calif. Mosquito Cont. Assoc. Proc. 25:12–13.

Dorer, R. E. 1957. Audio put to educational use. N. J. Mosquito Extermin. Assoc. Proc. 44: 59–60.

Harville, J. P. 1957. Public relations techniques in mosquito abatement programs. Calif. Mosquito Cont. Assoc. Proc. 25:70–71.

Preuss, A. F. 1957. Trustees' town hall problems and suggestions. Calif. Mosquito Cont. Assoc. Proc. 25:80–85. [Includes discussion].

Sameth, J. E. 1957. The value of public relations in mosquito control. N. J. Mosquito Extermin. Assoc. Proc. 44:108–109.

Washburn, G. E. 1957. The educational approach to source reduction. Calif. Mosquito Cont. Assoc. Proc. 25:72–74.

SUBJECTS NOT COVERED BY OTHER HEADINGS

Bohart, R. M. 1957. Biological studies, mosquito control, and the entomologist. Calif. Mosquito Cont. Assoc. Proc. 25:78–79.

Ferrigno, F. and MacNamara, L. G. 1957. A preliminary survey of mosquito production on the Egg Island public shooting and fishing grounds. N. J. Mosquito Extermin. Assoc. Proc. 44:92–98.

Granett, P. and Hansens, E. J. 1957. Effects of biting flies and mosquitoes on milk production. N. J. Mosquito Extermin. Assoc. Proc. 44:116–120.

MACNAMARA, L. G. 1957. Multiple use of our lands, especially marshland. N. J. Mosquito Extermin. Assoc. Proc. 44:103–106.

MAPES, G. W. 1957. Why a special tax to maintain a mosquito abatement district in northern Santa Clara County. Calif. Mosquito Cont. Assoc. Proc. 25:68–69.

NOVAK, D. 1956. Behandlung der *Aedes*-brutplätze mit insektiziden im winter. Zool. Listy 5(2):167–168. Germ. Sum.

PEPPER, B. B. 1957. Future leaders in mosquito control. N. J. Mosquito Extermin. Assoc. Proc. 44:121–124.

SU, S. C. and CH'U, M. C. 1956. A mosquito survey in Kai Feng and Chi Kung Shan of Hsin Yang, Honan Province. Acta Sinica 6(2):219–225. In Chin., Engl. Sum.

TINKER, M. E. 1957. Army mosquito surveillance in New Jersey. N. J. Mosquito Extermin. Assoc. Proc. 44:109–116.

TORRES CAÑAMARES, F. 1957. A propósito del *Anopheles marteri*, sen y Pru. Rev. de Sanid. e Hig. Pub. (Madrid) 31(3/5):101–105.

Erratum

In volume 17(4):335 of Mosquito News, section on Biography and History under Gray and Fontaine change pages 1–17 to read 18–39.

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